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USSR AND EASTERN EUROPE SCIENTIFIC ABSTRACTS
MATERIALS SCIENCE AND METALLURGY

No. 55

This serial publication contains abstracts of articles and news items from USSR and Eastern Europe scientific and technical journals on the specific subjects reflected in the table of contents.

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Aluminum and Its Alloys

USSR

UDC 669.715:621.78

HETEROGENIZING ANNEALING AS A MEANS OF INCREASING THE DEFORMABILITY OF INGOTS OF ALUMINUM ALLOYS BY PRESSING

Moscow TSVETNYYE METALLY in Russian No 3, 1978 pp 62-65

YELAGIN, V. I., ZAKHAROV, V. V., KUKUSHKIN, YU. N. and PONOMAREV, YU. I.

[Abstract] Ingots of standard aluminum alloys were subjected to ordinary homogenization annealing and homogenization annealing with subsequent heterogenization treatment at the temperature of minimal stability of the solid solution, then heated in an induction furnace to 380-400°C and pressed into angle shapes with wall thicknesses of 9 and 2 mm. Analysis of the experimental results clearly indicates the effectiveness of heterogenizing treatment from the standpoint of increasing the workability of these aluminum alloys by pressing. No deterioration of mechanical properties of the shapes produced was observed. Figures 2; references 8: 5 Russian, 3 Western.

USSR

THE CREATION OF NEW HIGH-STRENGTH ALUMINUM ALLOYS

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 3, 1978 pp 72-73

SIDORIN, I. I.

[Abstract] Six new aluminum alloys have been developed: MVTU-1, MVTU-2, MVTU-3, MVTU-4, MVTU-5 and MVTU-6. Author's certificates have been granted for the new alloys. MVTU-1 (Al32) has a high content of silicon and typical tensile strength 29-32 kg/mm². Copper and manganese increase the heat resistance of the alloy, which remains quite strong up to 350°C. Ductility is quite low. The alloys MVTU-2, MVTU-3, MVTU-4 and MVTU-5 are Al-Si-Cu alloys. MVTU-3 also contains 0.1-0.2% Ti, MVTU-4 contains 10-15% silicon carbide, and MVTU-5 contains 0.1-0.2% Cd. These alloys have good casting properties and can work at high pressures and temperature. MVTU-6 is designed for the manufacture of complex-shaped castings. It has high strength and ductility ($\delta = 10\%$, as compared to $\delta = 3\%$ for MVTU-1).

USSR

UDC 669.715:621.77

LAMINAR CONSTRUCTION MATERIALS BASED ON ALUMINUM AND ITS ALLOYS

Moscow TSVETNYYE METALLY in Russian No 4, Apr 78 pp 6-12

KORYAGIN, N. I.

[Abstract] An examination is made of the process of making laminar construction materials from aluminum and its alloys by plastic codeformation. In weld zones, the metal is joined tightly, and in channel zones an antiweld material is used, so that the opposite sides of the panel that is being formed are subjected to separate deformation. Thus the joining process is complicated both by the layered deformation typical of bimetal sheet production, and by the presence of welded and unwelded zones. An investigation is made of plastic flow and destruction of the metal during rolling. A special unit was built for making the channels by inflation with air or argon fed between the sheets while in the hot state in the press. The author considers the problems that arise in laminar sheet compositions and roll-welded panels based on aluminum and its alloys with copper, zinc, titanium and stainless steel. Applications of these special bimetal structures are discussed in electrical engineering, shipbuilding, refrigeration and solar heating panels. Figures 7; references 12: all Russian.

USSR

UDC 620.179.18:681.2

INFLUENCE OF HEATING ON THE PHYSICOMECHANICAL PROPERTIES OF ALUMINUM ALLOYS AND EVALUATION OF THESE PROPERTIES FROM THE SPECIFIC CONDUCTANCE

Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 14, No 2, Mar/Apr 78 pp 102-104 manuscript received 26 May 76

KISELEV, YU. A., DOROFEEV, A. L., POPOVICH, B. D. and CHERENKOVA, Z. V., Novosibirsk Aircraft Plant imeni V. P. Chkalov

[Abstract] An investigation is made of the physicomechanical properties and structure of aluminum alloys that are heated during use or manufacture, and a feasibility study is done on using a nondestructive method for checking the properties of the material on the basis of specific conductance measurements. The studies were done on sheets and structural shapes of D16, D19 and V95 aluminum alloy 2.0-2.5 mm thick. The specimens made for mechanical tests underwent repeated heat treatment. Heating was done in the MP-2UM laboratory muffle furnace in the temperature range from 150 to 500°C. The specimens were cooled in air. It was found that when the specimens are heated to the aging temperature the mechanical properties (ultimate strength, residual longitudinal extension, HRB) change only slightly,

with the exception of a sharp drop in residual longitudinal extension of Duralumin alloys. The structure retains the aged state. An additional temperature rise causes annealing and an eventual gradual improvement of strength and ductility accompanied by a drop in specific conductance. It is shown that the residual strength of metal that has been heated can be determined from its specific conductance if the initial values of these characteristics are known. Specially developed phase instruments for measuring conductance can be used for nondestructive testing of the strength properties of finished parts that have been plated, anodized and painted without removing the coatings. Industrial tests show that the method is quite accurate and reliable. Figures 2; references 3: all Russian.

USSR

UDC 620.187:539.43:620.178:38:669.715:620.19

INFLUENCE OF THE MICROSTRUCTURE OF D16 AND V95 ALUMINUM ALLOYS ON THE DEVELOPMENT OF FATIGUE CRACKS AT NORMAL AND LOW TEMPERATURES

Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 14, No 2, Mar/Apr 78 pp 38-42 manuscript received 26 May 77

OSTASH, O. P., Institute of Physico-Mechanics, Academy of Sciences UkrSSR, L'vov

[Abstract] The results of earlier studies show that resistance of a material to development of a fatigue crack depends considerably on the spread in the coefficient of stress intensity at the tip of the crack, and does not change with test temperature. An attempt is made in this paper to explain the previously found patterns of fatigue crack propagation, using the results of microstructural and electron-fractographic analysis. Foils were used to study the fine structure on the UYeMB-100K transmission electron microscope, and the microfractographic studies were done on the Stereoscan S4-10 scanning electron microscope. The studies were done on D16 and V95 alloys in different structural states and at different load levels. It was found that fatigue cracking of the investigated materials is determined by both large ($1-20 \mu\text{m}$) and small ($0.01-0.1 \mu\text{m}$) segregations of second phase. It is shown on the basis of the results that a prediction can be made of the parameters that correspond to a transition from the first to the second and from the second to the third regions of the kinetic diagram of fatigue fracture. Figures 4; references 14: 8 Russian, 6 Western.

USSR

UDC 620.178.3:539.43

PROBABILISTIC ESTIMATION OF FATIGUE PROPERTIES OF AN ALUMINUM ALLOY

Kiev PROBLEMY PROCHNOSTI in Russian No 3, Mar 78 pp 17-20 manuscript received 11 Apr 77

VORONKIN, N. F. and KARLASHOV, A. V., Kiev Institute of Civil Aviation Engineers

[Abstract] A probabilistic estimate is given of the endurance characteristics of D16 aluminum alloy in the 10^5 - 10^8 cycle endurance range. Fatigue testing was performed at 5000 cycles per minute, with 20 specimens tested at each stress level and the experimental results mathematically processed. The experimental results are presented in graphic form, allowing the endurance characteristics of the alloy to be estimated on the basis of the conditions of probability of failure in the 10^5 - 10^8 cycle range. Figures 4; references 7: all Russian.

USSR

UDC 669.71:539.4.019.2

CRACK PROPAGATION RESISTANCE IN AN ALUMINUM ALLOY PLUS STEEL WIRE COMPOSITE

Kiev PROBLEMY PROCHNOSTI in Russian No 4, Apr 78 pp 9-12 manuscript received 25 Jul 76

SHORSHOROV, M. KH., KUDRYASHOV, V. G., USTINOV, L. M., ZHAMNOVA, V. I. and RUDINTSKIY, YE. N., Institute of Metallurgy imeni A. A. Baykov, Academy of Sciences, USSR

[Abstract] The resistance to propagation of cracks across the direction of the metal fiber reinforcement was studied in a composite material based on an Al-Zn-Mg aluminum alloy reinforced with type EP322 stainless steel wire, containing not over 15% wire by volume. The properties of the composite were similar to those of an Al-W composite. A method is developed for determination of the critical length for stable crack growth. The stress intensity factor K_c at the tip of a growing crack is determined in the plane stress state. It is shown that for a composite with 14% wire, $K_c=207-240 \text{ kg/mm}^2$. References 5: 2 Russian, 3 Western.

Analysis and Testing

USSR

UDC 543.422.8

ESTIMATE OF THE ERROR IN X-RAY-SPECTRAL ANALYSIS OF A SINTER CHARGE IN A SYSTEM

Moscow ZAVODSKAYA LABORATORIYA in Russian Vol 44, No 2, 1978 pp 163-166
manuscript received 22 Oct 76

KOCHMOLA, N. M. and NIKOL'SKIY, A. P., All-Union Scientific Research Institute for Automation and Ferrous Metallurgy, Moscow

[Abstract] Since 1973, the sintering shop of the metallurgical plant has used a system of x-ray spectral analysis of the calcium oxide content in charge materials, including an x-ray analyzer and a sampling device. The collection, preparation and delivery of materials to the analyzer, as well as removal of materials from the analyzer are done automatically using a mechanical system described in this article. The automated system has remained calibrated for long periods of time (5 months in experiments). Figures 2; references 4: all Russian.

USSR

UDC 669.15'28-198:543.422.8

X-RAY SPECTRAL ANALYSIS OF FERRONICKEL

Moscow ZAVODSKAYA LABORATORIYA in Russian Vol 44, No 2, 1978 pp 167-169
manuscript received 14 Oct 76

ALEKSANDRK, T. D., KHLOPINA, T. N. and SHVARTS, D. M., "Gipronikel'" Planning Institute, Leningrad

[Abstract] The first Soviet plant to utilize electric smelting of oxide nickel ores to ferronickel analyzes the ferronickel with an automatic fluoroprint III EB x-ray spectrometer. The x-ray spectral methods of analysis of ferronickel was developed in two stages: analysis of the metallic components and then determination of the light elements such as sulfur, silicon and phosphorus. The results of studies to select the proper parameters of the installation and methods of preparation of samples are presented. The end result is the development of an express method for x-ray spectral analysis of ferronickel for seven elements equal in accuracy to other analysis methods. Analysis of one sample requires five minutes, excluding sample preparation time. Figures 1.

USSR

UDC 620.183.48

ON THE QUANTITATIVE X-RAY PHASE ANALYSIS OF TITANIUM ALLOYS

Moscow ZAVODSKAYA LABORATORIYA in Russian Vol 44, No 2, 1978 pp 190-192
manuscript received 17 Nov 76

BEKRENEV, A. N., Kuybyshev Polytechnical Institute imeni Kuybyshev

[Abstract] The most common method for the determination of the quantity of β -phase in titanium alloys is based on comparison of the integral intensities of the lines of the α and β phasing, utilizing an equation which includes a constant k. This article presents a recalculation of the value of constant k for various possible combinations of parameters of α and β phases of titanium and Cu K α radiation. Good agreement is achieved with experimental results. Figures 1; references 5: 4 Russian, 1 Western.

USSR

UDC 620.178.4/.6

ON A METHOD OF TESTING SPECIMENS FOR LOW-CYCLE FATIGUE STRENGTH

Moscow ZAVODSKAYA LABORATORIYA in Russian Vol 44, No 2, 1978 pp 211-214
manuscript received 14 Oct 77

DANILOV, YU. S.

[Abstract] The purpose of this work is to establish the influence of the factors of elastic energy reserve of the train of specimens often used in fatigue testing and the impact compressive force arising when one of the train of specimens fails on low-cycle fatigue strength and the stability of the results of testing. Specimens of steel, aluminum alloy, titanium alloy and bolts of titanium alloy were tested. It is found that the use of chain specimens increases the mean durability and the variation in results in comparison to testing of individual specimens. The most important factor influencing the durability of specimens in chains is the reserve of elastic energy of the chain, followed by the impact compressive loading. The number of specimens in a chain, type of stress concentrator, length of gage section and ductility of the material can significantly change the test results. The results indicate that there is a need for standardization of specimens for this type of test. Figures 1; references 4: 3 Russian, 1 Western.

USSR

UDC 621.791.052:620.193:621.78

A METHOD OF TESTING OF WELDED JOINTS OF DISPERSION-HARDENED ALLOYS FOR CRACK RESISTANCE DURING HEAT TREATMENT

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 5, May 78 pp 48-50

SKVOTSOV, YE. A., and GOLUBEV, V. N., Ufa Aviation Institute imeni S. Ordzhonikidze

[Abstract] Stress relaxation tests of specimens with welded seams allow comparative quantitative evaluation of the crack resistance of heat-resistant alloys during heat treatment, and also allow a study of the influence of individual factors, independently of others, which is impossible during testing of specimens reflecting the combined influence of various factors. The crack resistance of EP-718 alloy, hardened and annealed before welding, is determined as an example. Figures 5; references 13: 6 Russian, 7 Western.

USSR

UDC 621.791.052:669.419.4:620.179.1

A METHOD OF NONDESTRUCTIVE QUALITY TESTING OF THE WELDING OF JOINTS IN BIMETALS

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 5, May 78 pp 23-25

DROZD, M. S., SLAVSKIY, YU. I., BARON, A. A., Volgograd Polytechnical Institute; DUBEN', L. V., and DIKUN, V. N., All-Union Scientific Research Institute for Installation and Specialized Construction

[Abstract] Results are presented from determination of the possibility of testing of the hardness of seam metal produced by welding with a powder wire, developed at Volgograd Polytechnical Institute. The hardness of the metal was determined by a single measurement at each point on the surface of the seam using a VPI-3K instrument. This method of testing of seam quality provides the necessary accuracy and reliability of results and can be recommended for wide-scale use. No martensite component was found in the surface layer of the seams produced by automatic welding with powder wire. Figures 2; references 3: all Russian.

Beryllium

USSR

UDC 569.725:539.372

RECRYSTALLIZATION OF ULTRAFINE BERYLLIUM

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 4,
Apr 78 pp 78-79

KORNIYENKO, L. A., NIKOLAYENKO, A. A. and TARANENKO, I. A., Kharkov
Physico Technical Institute, Academy of Sciences Ukrainian SSR

[Abstract] Beryllium with a purity of more than 99.9% was subjected to a combination programmed deformation of cast ingots at 600-900°C in order to cause dynamic recrystallization and produce a large number of recrystallized grains with an average size of 1-2 microns. The deformed samples were annealed at 700-1000°C for periods ranging from 30 seconds to 100 hours. Determination of grain-growth activation energies showed that these values were approximately double the values for self-diffusion activation energy. The activation energies for creep were also almost double. This was explained by the significant quantity of dislocations in the grain boundaries of the fine-grain Be which require considerable energy for annihilation and render additional resistance to grain-boundary movement in the recrystallization process. Grain growth occurs at higher annealing temperatures where the grain-boundary dislocations acquire some mobility and promote a faster improvement of the boundary structure. Figures 2; references 5: 4 Russian, 1 Western.

USSR

UDC 669.017

GRAIN ORIENTATIONS OF CONDENSED BERYLLIUM FOILS

Ordzhonikidze IZVESTIYA VUZov, TSVETNAYA METALLURGIYA in Russian No 2,
1978 pp 119-124 manuscript received 9 Mar 77

KAPCHERIN, A. S., PAPIROV, I. I. and TIKHINSKIY, G. F., Khar'kov Physico-technical Institute

[Abstract] The purpose of this research was to construct the pole figures of condensed beryllium foils produced over a wide range of condensation temperatures (200-1000°C) and to determine the mechanism of formation of grain orientations. The foils were made from high-purity distilled beryllium. The metal was vaporized in vacuum and condensed on carbidized molybdenum sheets. The pole figures were produced by an automatic grain orientation goniometer attachment to an x-ray diffractometer. A scanning electron microscope with microanalysis attachment was used to study the surface structure of the condensates. The results show that vacuum condensation on an amorphous substrate forms axial grain orientations {001}, {1010} and {2023}. The type of grain orientation depends on the

substrate temperature. Two or three preferred orientations may coexist in the transition regions. Orientations {0001} and {10 $\bar{1}$ 0} arise due to formation and growth of the corresponding nucleating centers, whereas grain orientation {20 $\bar{2}$ 3} inherits orientation {100} in the initially formed β -Be, and is the result of oriented allotropic transformation (110) [111] β -Be \rightarrow (0001) [112 $\bar{0}$] α -Be. At condensation temperatures above 400°C, a vapor-liquid-crystal mechanism of crystallization replaces the vapor-crystal mechanism. Figures 4; references 11: 8 Russian, 3 Western.

Coatings

USSR

UDC 539.67:620.178

EXPERIMENTAL STUDY OF THE DAMPING PROPERTIES OF COMPOSITE COATINGS

Kiev PROBLEMY PROCHNOSTI in Russian No 12, Dec 77 pp 102-107 manuscript
received 20 Nov 76

YAKOVLEV, A. P., Institute of Problems of Strength, Academy of Sciences,
Ukrainian SSR

[Abstract] The problem of determination of the optimal relationships of physical and mechanical properties and geometric parameters of the components of composite materials, as well as their quantities, in order to produce the maximum or predetermined characteristics of damping of oscillations of the composite systems, is studied by experimental determination of curves which can be used as a basis for the manufacture of coatings and as a basis for methods of calculation of the damping effects of the coatings on structural elements. The application of such coatings to the rigid layers of composite materials leads to a significant increase in the damping properties of the sheet elements produced. The maximum oscillation decrement may be increased by as much as a factor of 50. The results of this study can be used to optimize high damping properties while retaining acceptable weight characteristics of coatings by optimizing the thickness of the layers. Figures 4; references 3: all Russian.

USSR

UDC 621.793.7

STRUCTURE AND COMPOSITION OF Ti-Al DIFFUSION COATINGS ON CARBON STEEL

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 4,
Apr 78 pp 73-75

SAMSONOV, G. V. (deceased), KAYDASH, N. G. and CHASTOKOLENKO, P. P., Uman
Pedagogical Institute imeni P. G. Tychina

[Abstract] The diffusion titanium coating of a previously aluminized carbon steel was investigated. Aluminizing of the steel was done using a powder mixture (85% Fe-Ti-Al + 11% Al₂O₃ + 4% NaF) at 1100°C for 1-6 hours to impregnate the steel and a second powder mixture (77% Ti + 20% TiO₂ + 3% NH₄Cl) at 950-1150° for 1-9 hours to apply the titanium coating. The Al content in the outer zone was 14% after impregnation at 1100°C for one and three hours while the inner zone contained 6.5% Al. Application of the titanium coating causes the aluminum to be redistributed under a titanium carbide layer from a maximum of 11.5% to 6.5% Al. Carbon, manganese and silicon in the steel are also redistributed as a result of the titanium diffusion coatings. Figures 3.

USSR

WEAR-RESISTANT ELECTRIC-SPARK METALLIC AND INTERMETALLIC COATINGS ON A
TITANIUM ALLOY

Kishinev ELEKTRONNAYA OBRABOTKA MATERIALOV in Russian No 2, 1978 pp 25-28

LAZARENKO, B. R., TKACHENKO, YU. G., MIKHAYLOV, V. V., GORBATOV, I. N.,
YURCHENKO, D. Z., and PARKANSKIY, N. YA., Kishinev, Kiev

[Abstract] A study is made of the conditions of production and characteristics of friction of electric-spark metallic and intermetallic coatings on VT1-0 titanium alloy, produced by treatment of compact specimens of Al, Co, Cr, NiAl, and TiAl measuring 15x15x5 mm and wire electrodes of these same materials and their composites with a vibrating electrode tool. The coatings formed were found to consist of two zones, the upper with a microhardness of 800-1000 kgf/mm² and a thickness of 20-50 µm, the lower with a microhardness of 500 kgf/mm² and a thickness of 8-10 µm. It is found that in the 20-400°C temperature interval, the wear rate and coefficient of friction generally increase upon heating of the specimens. At higher temperatures, these characteristics stabilize or decrease. Coatings produced by alloying with cobalt and chromium showed the greatest wear resistance at high temperatures. Electron microscope photographs of the friction surfaces of coatings produced by addition of TiAl after testing at 600 and 800°C are presented. The optimal structure of the surface layer is found to be heterogeneous, providing elastic-plastic contact during friction. Figures 3; references 5: all Russian.

Composite Materials

USSR

UDC 621.793

THE STRENGTH PROPERTIES OF BIMETALLIC MOLYBDENUM-TUNGSTEN COMPOSITES

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 2, Mar/Apr 78
pp 147-150 manuscript received 8 Jul 77

GLAGOLEV, V. V., DEMENT'YEV, L. N., FEDOROVA, V. N., KOROLEV, YU. M. and
SOLOV'YEV, V. F., Moscow

[Abstract] Specimens of bimetallic molybdenum-tungsten composites produced by reducing tungsten hexafluoride with hydrogen are used to study the strength and creep in the 20-1800°C temperature range. The tungsten was precipitated onto the outer surface of tubular blanks of molybdenum single crystals, after which the composite was annealed in a vacuum at 1300°C for two hours; then the coating was ground and electrically polished. Bimetallic composites based on molybdenum single crystals and fluoride tungsten yield brittle fractures at temperatures below 300-500°C. Their strength is 25% less than the strength of molybdenum single crystals. At temperatures over 800°C, the bimetallic composites are stronger, the difference increasing with the increase in relative tungsten thickness. Figures 3; references 3: all Russian.

USSR

UDC 621.793:533.6.011

ON THE POSSIBILITY OF PRODUCING FIBER COMPOSITE MATERIALS WITH REFRactory
MATRIX BY PLASMA ATOMIZATION

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 2, Mar/Apr 78,
pp 142-146 manuscript received 28 Jun 77

KOSTIKOV, V. I., SHESTERIN, YU. A., MILOV, V. P., SHORSHOROV, M. KH.,
TSIRLIN, A. M., KUDINOV, V. V., KATINOVA, L. V. and MIT'KIN, A. I., Moscow

[Abstract] A study is made of the atomization of a titanium matrix onto strengthening fibers in a controlled atmosphere. Fibers of boron and silicon carbide, as well as fibers with various coatings were tested in the study. It was found that atomization of the titanium matrix onto the fibers was possible only in a controlled atmosphere. The strength of the fibers was better retained when they were first coated with titanium or boron carbide in coatings 2-4.5 µm thick. Preheating of the fibers to 500°C in an inert atmosphere did not result in loss of fiber strength. Figures 3; references 5: 3 Russian, 2 Western.

USSR

UDC 621.77.0

ON THE CALCULATION OF THE KINEMATICS OF DEFORMATION OF COMPOSITE MEDIA.
REPORT 1

Moscow IVUZ. CHERNAYA METALLURGIYA in Russian No 3, 1978 pp 72-74 manuscript
received 11 May 77

KUCHERYAYEV, B. V. and POLUKHIN, P. I., Moscow Institute of Steel and Alloys

[Abstract] A method is presented for construction of the kinetmatically possible fields of velocities, which can be used to calculate the parameters of joint deformation of a continuous medium and reinforcing bodies included in it. The method of superposition of potential velocity fields is used to construct the reference field of velocities in the area of deformation of the medium, represented as a curved strip in a system of Euler coordinates. From this construction, the flow function $\psi = \psi(E_i)$, field of velocities $v_k = v_k(E_i)$ and deformation stress tensor components $\xi_{ik} = \xi_{ik}(E_i)$ are produced. Then the reinforcing medium is introduced and analyzed, thus producing a composite of the two media. The method suggested can be used to analyze the kinematics of composite, granulated, powdered and other heterogeneous media in the process of pressure working. Figures 2; references 2: both Russian.

USSR

UDC 539.4:678.067.5

DEFORMATION AND FRACTURE OF UNIDIRECTIONALLY REINFORCED COMPOSITE WITH
NONLINEARLY ELASTIC MATRIX

Riga MEKHANIKA POLIMEROV in Russian No 1, Jan/Feb 78 pp 55-61 manuscript
received 5 Jan 77

RIKARDS, R. B. and CHATE, A. K., Institute of Polymer Mechanics, Academy of Sciences, Latvian SSR

[Abstract] A study is made of the determination of the stress-strain state in the component of the unidirectionally reinforced composite with non-linearly elastic matrix, performed by the method of finite elements. The method of solution is based on approximation of the stress-strain diagrams by piecewise-linear sections with subsequent solution of the problem of determination of the stress-strain state in increments. Strength surfaces of the composites are produced considering the inelastic deformation of the matrix. It is found that the most heavily loaded point in a composite is the boundary between the fibers and the matrix. During compression of a composite across the direction of the fibers, failure begins due to tensile stresses in the direction perpendicular to the direction of compression. The closeness between the stress maximum and the separation boundary indicates

the significant role of the properties of this boundary in the failure of a composite. Studies have shown that, depending on the reactions between the components of the composite, the division boundary may be stronger than the matrix. The calculation method presented in this article allows this factor to be considered. Figures 6; references 10: 4 Russian, 6 Western.

USSR

UDC 539.4:678.067.5

STUDY OF THE LONG-TERM STRENGTH OF CARBON-GRAFITE COMPOSITE MATERIAL AT VARIOUS TEMPERATURES

Riga MEKHANIKA POLIMEROV in Russian No 1, Jan/Feb 78 pp 45-50 manuscript received 23 May 77

RABOTNOV, YU. N., STEPANYCHEV, YE. I., KILIN, V. S., KOLESNIKOV, S. A., MATYTSIN, V. S., MAKHMUTOV, I. M. and REZANOV, V. I.

[Abstract] A study is made of the long-term strength of one of the primary composites in use today, with a carbonized matrix without coating at various temperatures (up to 550°C) in uniaxial extension. The results presented are needed for the development of recommendations for the use of such composites for the manufacture of load-bearing parts used over long periods of time and exposed to heat. The specimens studied consisted of polyphenylsiloxane binder filled with cords consisting of 4800 elementary carbon fibers each (filament diameter 6-8 µm, mean modulus of elasticity and tensile strength 22000-25000 kg/mm² and 220-230 kg/mm²). The experiments were conducted on specimens cut from rectangular plates along the long boundary. The data produced indicate that raising the temperature to 500-550°C has the greatest influence on the loss of load-bearing capacity of the material studied, acting on the composite in concert with the applied stresses for 10 hours and more, which is sufficient for the development of oxidizing processes in the carbonized matrix. Application of protective coatings decreases the surface for interaction with the oxygen, increasing the oxygen resistance of these composites. Figures 4; references 3: all Russian.

USSR

UDC 678.067.5:539.4

DANGER OF LAYER SEPARATION IN SHORT METAL COMPOSITE RODS IN AXIAL COMPRESSION

Riga MEKHANIKA POLIMEROV in Russian No 1, Jan/Feb 78 pp 27-33 manuscript received 22 Feb 77

TARNOPOLO'SKIY, YU. M., KHITROV, V. V., SHEMSHURIN, M. V. and VASILEVSKIY, V. M., Institute of Polymer Mechanics, Academy of Sciences, Latvian SSR

[Abstract] Composite rods enclosed in a thin metal shell are tested. These metal composite rods combine high rigidity and strength in the direction of the reinforcing fibers with good resistance to shear and separation between layers, due to the presence of the metal shell. Early separation of layers in compression of rods with various cross-sectional shapes made of carbon-reinforced plastic in a duralumin shell is discovered. It is found that the experimental data agree satisfactorily with the critical stresses defined by the energy approach. It is shown that in composite rods, the specific work of layer separation decreases with increasing angle of the reinforcement. Steps are suggested to increase the resistance to layer separation. Figures 8; references 12: 9 Russian, 3 Western.

USSR

UDC 539.216

ON THE CALCULATION OF THE PERMISSIBLE SHIFT ANGLE OF FIBERS DURING "CROSS" REINFORCEMENT OF SHEETS PRODUCED BY ROLLING

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 2, Mar/Apr 78 pp 155-158 manuscript received 20 Sep 77

MANUYLOV, V. F., KOLPASHNIKOV, A. I., KIKHONOV, A. S. and PAVLOV, YE. A., Moscow

[Abstract] A study is made of the process of the production of sheets of Al-B composite material with low anisotropy of physical properties. To increase the "transverse" strength of the material, the fibers of all layers can be shifted by a certain angle from their original direction. A method is suggested for determining the permissible shift angle of fibers as a function of the volumetric fraction of fibers, their strength and the properties of the material. It is proved possible to control the anisotropy of the properties of sheets by variation of the fiber shift angle in all layers or in some of the layers of a compound blank within the limits of the permissible value (different for each composition), determined by the method of calculation presented. Figures 2; references 4: all Russian.

USSR

UDC 539.4:678

REINFORCING PHOSPHATE FROM CERAMIC WITH SILICON CARBIDE WHISKERS

Riga MEKHANIKA POLIMEROV in Russian No 2, Mar/Apr 78 pp 253-256 manuscript received 19 Nov 76

SHCHETANOV, B. V., PRILEPSKIY, V. N., LAPIDOVSKAYA, L. A., CHERNYAK, A. I. and ROMANOVICH, I. V., All-Union Scientific Research Institute of Aviation Materials, Moscow

[Abstract] An investigation is made of the influence of SiC whiskers on the bending strength of phosphate foam ceramic. Graphs were plotted for the properties of foam ceramics based on phosphate binders as dependent on porosity, and the results were then used to determine the way that elastic and strength characteristics depend on the whisker concentration. Experimental results show that the elastic modulus and bending strength of composition foam ceramic decrease with an increase in porosity, and increase with a rise in the volumetric content of reinforcing fibers. The addition of 12.3% SiC whiskers in the foam ceramic composition more than triples the bending strength of the material. The strengthening effect is attributed to the fact that the whiskers act as a barrier to the propagation of matrix cracks, thus increasing the work of fracture. It is shown that in calculating the strength of a composition foam ceramic, account must be taken of the fact that the whiskers reinforce only the volume of the material occupied by solid matter, and not the pores. Figures 3; references 6: 2 Russian, 4 Western.

Conferences

USSR

ON THE WORK OF THE SCIENTIFIC AND TECHNICAL SEMINAR "NEW COMPOSITE MATERIALS AND PROCESSES FOR PRODUCING THEM"

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 2, Mar/Apr 78
pp 173-175

BAKARINOVA, V. I.

[Abstract] The second seminar on this problem was held 16-20 November 1976 at the Exhibition of Achievements of the National Economy of the USSR in Moscow, and was attended by more than 200 representatives of 60 scientific research institutes, industrial enterprises, and planning and educational institutions from 20 cities. It was noted that the Academy of Sciences USSR is devoting a great deal of time and attention to the organization and coordination of fundamental and applied studies on the problem of composite materials. The purpose of the seminar was to familiarize engineering, technological and design workers with new composite materials and methods of their production, and to allow the exchange of experience in the application of these materials. Topics covered included: the theoretical principles of the development of modern CM; new metal and nonmetal-based composites; reinforcing materials; the effects of superplasticity and shape memory in composites; carbon composites; polymer-based composites; thin sheet carbon-reinforced plastics; composite electrically conductive chemical fibers; and the practical application of composites.

USSR

ON THE WORK OF THE SEMINAR "PHYSICS" AND CHEMISTRY OF PROCESSING OF MATERIALS BY CONCENTRATED FLUXES OF ENERGY

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 2, Mar/Apr 78
pp 172-173

UGLOV, A. A.

[Abstract] The 68th seminar on the subject mentioned in the title was held 29 September 1977 at the Institute of Metallurgy imeni A. A. Baykov, Academy of Sciences USSR. The seminar was chaired by Academician N. N. Rykalin, and was attended by over 80 persons representing organizations from Moscow, Minsk and Kazan'. The seminar was dedicated to the results of the International Round Table on Plasma Polymerization and Surface Phenomena and the Third International Symposium on Plasma Chemistry. Subjects discussed included methods of diagnosis of an optically dense plasma; elementary processes in plasmas and problems related to nonequilibrium plasmas; plasma technology and the increasing importance of engineering developments in plasma chemistry; the production of molybdenum carbide with cubic lattice

recently achieved in Japan; plasma processes in metallurgy and inorganic materials technology; thermodynamic calculation of the equilibrium composition of a plasma; processes of transfer in plasma; reducing metallurgy; and HF plasmas.

USSR

ALL-UNION CONFERENCE ON THE PRODUCTION, PROPERTIES AND APPLICATION OF REFRACTORY COMPOUNDS

Moscow TSVETNYYE METALLY in Russian No 4, Apr 78 p 84

[Abstract] An All-Union Conference on the production, properties and uses of refractory compounds was held in Kiev 15-17 February 1978 in honor of G. V. Samsonov's sixtieth birthday. The conference was attended by 437 people, representatives of more than 100 organizations and enterprises from 40 cities of the Soviet Union including Moscow, Leningrad, Kiev, Minsk, Kishinev and others. The conference was opened by Academician V. I. Trefilov, director of the Institute of Problems of Materials Science of the Ukrainian Academy of Sciences. Twenty-four reports were presented in the plenary sessions. An introductory report by S. Ya. Plotkin was dedicated to the scientific activity of G. V. Samsonov. The various reports dealt with new methods of synthesizing powders and single crystals of refractory compounds, the production of ultrafine powders, and possibilities of controlling the purity of synthesized powders. S. A. Kutolin, L. F. Pryadko and others examined the nature of refractory compounds in the light of electron theory. R. A. Andriyevskiy surveyed research on new effects now being studied in the investigation of refractory compounds. New uses of refractory compounds include their application of carbon-based materials, as discussed by V. I. Kostikov and V. S. Dergunova. It was recommended that annual conferences be held on Samsonov's birthday.

USSR

UDC 669.715

THE ALUMINUM-78 CONFERENCE IN SZÉKESFEHÉRVÁR

Moscow TSVETNYYE METALLY in Russian No 4, Apr 78 pp 55-57

[Abstract] The article gives summaries of some papers by Soviet scientists that were to be presented at a conference to be held in Székesfehérvár, Hungary, in May 1978. The titles and authors are: "Problems of Development of Aluminum Alloy Technology" by A. F. Belov, "Expansion of Effective Utilization of Aluminum Alloys" by F. I. Kvasov and I. P. Erlikh, "Experience in Vacuum Treatment of Aluminum Alloys" by G. S. Makarov and

V. A. Zasyppkin, "Ingot Casting in an Electromagnetic Ingot Mold" by G. A. Balakhontsev, "Granulatable Aluminum Alloys and Technology for Making Them" by V. I. Yelagin and A. I. Kolpashnikov, "Continuous Heat Treatment of Strips Made from Aluminum and AMg2 Alloy" by A. I. Baturin and V. P. Mitin, "Coil Drawing of Aluminum Alloy Tubing" by N. A. Sorokin and V. A. Moshkin, and "Producing Stamped Items with Variable Cross Section" by V. I. Yakovlev,, M. F. Zakharov and V. N. Lukashenko.

Glass and Ceramics

USSR

PLASMA WORKING OF GLASS

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 2, Mar/Apr 78
pp 57-63 manuscript received 5 Jul 77

VURZEL', F. B., NAZAROV, V. F., POPOVA, YE. M., KHODOROV, F. S. and
CHEPIZHNYY, K. I., Moscow

[Abstract] Results are presented from chemical, petrographic and electron-microscope analysis of specimens of glass after plasma working. The chemical composition of the initial glass was as follows, wt. %: 72SiO₂, 1.8Al₂O₃, 0.1Fe₂O₃, 6.8CaO, 4.0MgO, 13.7Na₂O, 1.2K₂O, 0.4SO₃. Also, results are described from determination of the mechanical and thermo-physical characteristics of the glass. Plasma working of glass is found to lead to modification of its surface layer. The remelted glass has significantly altered micro- and macrostructure, chemical composition and thermo-physical properties, leading to changes in the usage characteristics of the entire sheet of glass. Figures 4; references 14: 13 Russian, 1 Western.

Graphite

USSR

UDC 620.17+661.666.2

STUDY OF THE ANISOTROPY OF STRUCTURAL GRAPHITES AS TO PHYSICAL-MECHANICAL PROPERTIES AND THE PARAMETERS OF ACOUSTICAL NONDESTRUCTIVE TESTING

Kiev PROBLEMY PROCHNOSTI in Russian No 12, Dec 77 pp 76-79 manuscript received 30 Nov 76

LIVENTSEV, V. D., LUSHNIKOV, G. A., and ANUFRIYEV, YU. P., Moscow

[Abstract] The influence of the degree of orientation of particles of filler and pore shape may weaken the correlation of the propagation velocity of ultrasonic P-waves with strength, Young's modulus and density of graphite specimens. Therefore, parallel studies are performed of the variation in physical and mechanical properties and parameters determined in acoustical nondestructive testing (US wave velocity and logarithmic oscillation decrement as a function of the angle of cutting of the specimens). The tests were performed on commercial large-grain graphites. The angle of disorientation, the angle of change in the direction of sound transmission, within which errors of measurement of ultrasound do not exceed a predetermined permissible limit, is estimated. It is found that the change in the anisotropy of physical and mechanical properties which occurs during pressing is accompanied by a change in density. The adjusted ultrasound velocity (ratio of ultrasound velocity to material density), however, changes little, so that a decrease in disorientation angle has little influence on the accuracy of estimation of density and strength on the basis of ultrasound velocity. Figures 4; references 8: all Russian.

USSR

UDC 539.4.419

STRENGTH AND DEFORMATION PROPERTIES OF GRAPHITES WITH CYCLICAL CHANGES OF LOAD AND TEMPERATURE

Kiev PROBLEMY PROCHNOSTI in Russian No 4, Apr 78 pp 42-45 manuscript received 29 Jun 77

UMANSKIY, E. S., USKOV, YE. I., BOGOMOLOV, A. V., and ALEKSYUK, M. M., Kiev

[Abstract] This article presents the results of a study of the long-term strength of two types of reactor graphites under constant and cyclically changing loads and temperatures. The tests were performed on specimens of type VPG graphite, and graphite with a mean density of 1.8 and 1.65 g/cm³ (SPG graphite). Standard tensile test specimens were cut both parallel and perpendicular to the axis of the graphite. The result of testing of the two types of graphite are presented in the form of creep and long-term strength curves. Significant anisotropy of strength properties was found in both types of graphite. The long-term strength of the denser VPG graphite was twice that of the SPG graphite. The fractures of the specimens showed the material to be heterogeneous, with individual inclusions of coke crumb and many pores. A photograph of a typical fracture is presented. Figures 7; references 5: all Russian.

Heat Treatment

USSR

UDC 669.715:621.78

CONTINUOUS HEAT TREATMENT AND DRESSING OF ALUMINUM ALLOY STRIPS

Moscow TSVETNYYE METALLY in Russian No 4, Apr 78 pp 57-60

BATURIN, A. I., MITIN, V. P., TSUKROV, S. L. and SHUR, I. A.

[Abstract] A system for continuous heat treatment of aluminum alloy strip is described in which the heat is supplied to the metal through jets that create an air cushion. Tension machines are used for straightening. Annealing is done in a multisection electric furnace with seven heating sections and four cooling sections. The air jets blowing over the strip prevent carbon deposits by rapid evaporation of rolling oils. The continuous heat-treat line can be used for aluminum and AMts, AMg2, AMg3 and AMg6 alloys with tensile strength up to 30 kgf/mm² in thicknesses of 0.5-2 mm and widths of 800-1560 mm. The capacity of the line is 6-8 metric tons per hour. The resultant material is fine-grained with a minimum of anisotropy and scalloping. The area of the recrystallization grain of AMts sheet is one-tenth the size resulting from batch annealing. Strength properties are also somewhat higher for continuously annealed sheet. Figures 3.

Magnesium

USSR

UDC 539.385:620.193.2:669.721.5

THE GROWTH OF FATIGUE CRACKS IN MA12 MAGNESIUM ALLOY IN AIR AND IN A VACUUM

Kiev PROBLEMY PROCHNOSTI in Russian No 3, Mar 78 pp 12-16 manuscript
received 2 Feb 77

GRINBERG, N. M., SERDYUK, V. A., ZMEYEVETS, S. G., OSTAPENKO, I. L.,
MALINKINA, T. I., and KAMYSHKOV, A. S., Khar'kov

[Abstract] This work attempts to determine the macroscopic characteristics of crack growth in MA12 (T6) magnesium alloy, and the related microscopic peculiarities of plastic deformation and the failure mechanism. Specimens of MA12 alloy (2.9% Nd, 0.44% Zr) were stamped from a heat-treated sheet, then notched. The specimens were mechanically and electrolytically polished before testing. Crack growth rate is significantly lower in a vacuum than in air under all conditions. Crack growth can be divided into three stages with different rates of acceleration. The mechanism of fatigue failure is the same in a vacuum and in air: brittle intragrain fracture during the slow stage, then mixed fracture during the fast stage of crack propagation. The growth of a fatigue crack is accompanied by the formation of a plastic zone at its tip. Figures 4; references 11: 7 Russian, 4 Western.

Mechanical Properties

USSR

UDC 669.28:620.1

INFLUENCE OF ALLOYING AND HEAT TREATMENT ON THE MECHANICAL PROPERTIES OF THIN-SHEET MOLYBDENUM

Moscow TSVETNYYE METALLY in Russian No 3, 1978 pp 72-73

NESGOVOROV, V. V., TEGAY, Z. F., MIKHRIDINOV, R. M. and OBCHINNIKOV, M. A.

[Abstract] A study was made of the influence of small additive elements (0.12% Mn, 0.03% LaB₆, 0.025% B) on the ductility of molybdenum sheets (0.1-0.8 mm) in the annealed state. The tests showed significant improvement of the quality of parts produced: rejection of parts due to cracks was 5-10% in comparison to 68% in the initial molybdenum. The best results were produced following the addition of 0.025% B, with a maximum of 5% rejection. The improvement of ductility resulted from the deoxidizing effect of the additives, as well as their modifying influence in the formation of fine structure in the process of heat treatment. The positive influence of boron on molybdenum ductility also results from the fact that boron facilitates redistribution of carbon in the molybdenum matrix.

USSR

UDC 621.771:620.177:65.011.54

ESTIMATE OF HETEROGENEITY AND PREDICTION OF MECHANICAL PROPERTIES OF STEEL

Moscow ZAVODSKAYA LABORATORIYA in Russian Vol 44, No 2, 1978 pp 214-217
manuscript received 3 Jan 77

SELEZNEV, V. A., ISAYEV, YE. I., SURGUCHEV, A. N., KOLESNIK, L. V. and SIDOROVA, T. YA., Dneprodzerzhinsk Industrial Institute imeni Arsenichev

[Abstract] A statistically well-founded method for estimation and testing of the mechanical properties of finished rolled products must be based primarily on determination of measures of the heterogeneity within and between melts using the rules of addition of dispersion for processing of the results of mechanical testing of melts over long intervals of time. The use of correlation equations for the mechanical indicators based on the chemical composition of a melt allows complete determination of the structure of a general measure of heterogeneity, but does not always help to increase the accuracy of the prediction of the level of properties of an individual batch of metal produced from a melt. Figures 1; references: 2: all Russian.

Nuclear Science and Technology

USSR

LOSS OF VOLATILE FISSION PRODUCTS INTO THE ATMOSPHERE DURING OPERATION OF NUCLEAR POWER PLANTS AND INSTALLATIONS FOR THE REGENERATION OF SPENT FUEL AND PROSPECTS FOR TRAPPING OF THESE PRODUCTS

Moscow ATOMNAYA ENERGIYA in Russian Vol 44, No 2, Feb 78 pp 145-149

GALKIN, B. YA., GEDEONOV, L. I., DEMIDOVICH, N. N., LYUBTSEV, R. I., PETRYANOV, I. V., SADOVSKIY, B. F., SOKOLOV, V. N. and TROFIMOV, A. M.

[Abstract] General discussion is presented of the problem of exhausting volatile fission products into the atmosphere, specifically referring to krypton-85, iodine-129 and other long-lived isotopes which may accumulate in the atmosphere in relatively large quantities if nuclear power engineering continues to grow at its present rate. The use of metal fabric filters to return the valuable powdered products produced during fuel regeneration and fuel element manufacture to the technological process is advocated.

References 24: 15 Russian, 9 Western.

USSR

PHYSICAL CHARACTERISTICS OF THE FUEL OF FAST-NEUTRON POWER REACTORS AND THEIR INFLUENCE ON THE FUEL CYCLE

Moscow ATOMNAYA ENERGIYA in Russian Vol 44, No 2, Feb 78 pp 140-145

BAKUMENKO, O. D., IKHLOV, YE. M., KULAKOVSKIY, M. YA., ROMASHKIN, B. G., TROYANOV, M. F. and TSIKUNOV, A. G.

[Abstract] A study is made of the basic physical characteristics of spent fuel: isotopic composition, activity of fission products and residual heat liberation. Data are presented on the accumulation of the trans-plutonium elements in spent fuel and the influence of these elements on activity and residual heat liberation. The influence of higher isotopes of plutonium on the activity of the fuel and the radiation situation when working with the plutonium fuel is analyzed. Based on analysis of the activity of the fuel, the requirement for the degree of purification of the fuel of fission products during chemical processing are determined. The dynamics of the change of activity of fission products and residual heat liberation of fuel with reduced holding times of spent fuel are studied. The primary drop in activity of spent fuel occurs during the first 1/2 year; if the holding time is less than 1/2 year, problems of gas activity must be analyzed. All stages of the fuel cycle are interconnected and require combined technical and economic analysis considering the peculiarities of the fuel used. References 5: 3 Russian, 2 Western.

USSR

PHYSICAL AND TECHNICAL ASPECTS OF NUCLEAR AND CHEMICAL SAFETY OF NUCLEAR POWER PLANTS WITH GAS-COOLED FAST-NEUTRON REACTORS USING N_2O_4

Moscow ATOMNAYA ENERGIYA in Russian Vol 44, No 2, Feb 78 pp 137-140

NESTERENKO, V. B., SHAROVAROV, G. A., KOVALEV, S. D. and TRUBNIKOV, V. P.

[Abstract] Safety is an important factor in nuclear power plant design. The use of a dissociating coolant such as N_2O_4 allows the creation of powerful nuclear power plant units with fast-neutron reactors, having the advantage over other types of the use of a single-loop system for conversion of heat, based on the gas-liquid cycle. A reactor with three loops, each using 500 MW turbines, is purely gas cooled when this cycle is used. The use of this cycle also improved reactor safety due to the large quantity of coolant present in the reactor in comparison to the rate of coolant flow, and the disappearance of the need for highly reliable liquid-metal first-loop coolant pumps. The impact of such an installation on the environment with respect to radiation leakage and heat pollution is also considered satisfactory. Estimates of the danger represented by such a power plant indicate that it is no more dangerous than a conventional fossil-fuel power plant of the same capacity. Figures 3; references 6: 5 Russian, 1 Western.

USSR

BASIC TECHNICAL PROBLEMS AND PROSPECTS FOR THE CREATION OF GAS-COOLED FAST-NEUTRON REACTORS USING DISSOCIATING COOLING WITH POWER CAPACITIES OF 1200-1500 MW

Moscow ATOMNAYA ENERGIYA in Russian Vol 44, No 2, Feb 78 pp 131-136

KRASIN, A. K., NESTERENKO, V. B., TVERKOVKIY, B. YE., ZELENSKIY, V. F., NAUMOV, V. A., GOL'TSEV, V. P., KOVALEV, S. D. and KOLYKHAN, L. I.

[Abstract] Preliminary technical and economic characteristics of a nuclear power plant with a fast neutron reactor with an electrical power rating of 1200-1500 MW have been determined on the basis of neutron-physical, thermal, hydraulic and technological calculations and plan developments of the reactor and the primary accessory equipment of the nuclear power plant. The advantages of such a plan are listed. Reactors using N_2O_4 with 1000 MW electrical power capacity, according to calculated data, could produce up to 500-900 kg of plutonium per year. These same reactors, operating as reprocessors, could produce up to 1400 kg/yr. The proposed power plant satisfies today's requirements as to technical and economic indicators and would be safe in operation. A thermal power

rating of 1000 MW is selected, based on consideration of the possibility of using the reactor as an independent power unit, capable of producing low-potential heat and electric power in addition to the production of secondary nuclear fuel. Figures 2; references 8: 6 Russian, 2 Western.

USSR

NUCLEAR SUPERHEATING OF STEAM, RESULTS AND PROSPECTS AT THE PRESENT STAGE

Moscow ATOMNAYA ENERGIYA in Russian Vol 44, No 2, Feb 78 pp 126-131

BATUROV, B. B., ZVEREVA, G. A., MITYAYEV, YU. I. and MIKHAN, V. I.

[Abstract] Results are presented from operation of nuclear power plants and the prospects are analyzed for nuclear superheating on the example of a block-section reactor of high capacity, the RBMKP, the most advanced design in this respect. The peculiarities and basic problems involved in the organization of nuclear steam superheating, including the development of fuel elements capable of producing steam at 500-540°C and pressures of 90-130 kg/cm² with thermal loads of up to $1 \cdot 10^6$ kcal/(m²·hr) with acceptable neutron-physical characteristics and economically expedient uranium burn-up rates are described. Results achieved in this direction at the Beloyarsk Nuclear Power Plant are briefly outlined. It is pointed out that reactors with nuclear steam superheating allow operation as both electric power and steam supply sources, and the use of high speed turbines operating with superheated steam can significantly reduce heat pollution of the environment. Figures 5; references 11: all Russian.

USSR

UDC 621.039.54

PROSPECTS FOR THE DEVELOPMENT OF THE CHEMICAL TECHNOLOGY OF PRODUCTION FACILITIES IN THE NUCLEAR POWER FUEL CYCLE

Moscow ATOMNAYA ENERGIYA in Russian Vol 44, No 2, Feb 78 pp 118-125
manuscript received 11 Aug 77

LASKORIN, B. N., KRUGLOV, A. K., SKOROVAROV, D. I., SEMENOV, V. F., CHUMACHENKO, B. A., FILIPPOV, YE. A., BABENKO, A. M. and VLASOV, YE. P.

[Abstract] The expanding development of atomic energy in the USSR is accompanied by an increase in the significance of chemical and radiochemical processes involved in the processing of natural uranium raw materials and the regeneration of spent nuclear fuel, in the production of new types of

fissionable materials and other production processes involved in the nuclear power-fuel cycle. This article studies the achievements and prospects for development of these processes, including systems analysis and mathematical modeling of the development of production processes, processing of uranium raw materials, isotopic separation, the manufacture of fuel compositions, and regeneration of spent fuel. The primary task for the nuclear industry at the present time is further to increase the economy and effectiveness of the technological systems of existing and planned facilities. Scientific research work should be directed toward improvement of the purification of valuable elements to remove fission products, toward the selection of optimal relationships of extraction and sorption operations in the process of regeneration, determination of the possible usage life of extraction and sorption systems to replacement or regeneration, and also toward increasing the purification of plutonium and neptunium and the use of systems safe from fire, explosion and radiation. References 43: 33 Russian, 10 Western.

Power Metallurgy

USSR

UDC 621.762

HYDROSTATIC PRESSING OF A MIXTURE OF TITANIUM DIBORIDE AND TITANIUM CARBIDE POWDERS

Kiev POROSHKOVAYA METALLURGIYA in Russian No 4, Apr 78 pp 85-89 manuscript received 8 Apr 77

MURASHKO, R. YE., SUMAROKOV, V. N., BOSATINA, T. A., BORISENKO, V. V., STRUK, L. I., SHVAB, S. A. and YUNAK, V. A., All-Union Scientific Research and Planning Design Institute of Metallurgical Machine Building and the Institute of Problems of Materials Science, Academy of Sciences Ukrainian SSR

[Abstract] A powder mixture consisting of 80% TiB₂ and 20% TiC was mixed to study the various processes occurring as a result of hydrostatic pressing. After mixing, the resultant powder had a composition (in wt %) of: 70.5 Ti, 4.37 total C, 0.48 free C, 22.5 B and 1.25 Fe. Pressing was done under loads of 500, 1000, 1500, 2000, 3000 and 4000 kgf/cm² using a synthetic rubber plasticizer with part of the samples receiving a vacuum treatment prior to pressing. Sample density increases intensively between 500 and 3000 kgf/cm². Higher pressures provide almost no increased density, and cracks form. The vacuum treated samples had a density 0.5-1.5% higher in the 1500-2500 kgf/cm² interval than the untreated ones and at 3700 kgf/cm² the action of a stratification phenomenon was observed along with crack formation. The effect of time under pressure for periods of ~0 (instantaneous), 1, 3 and 5 minutes showed that density increases very little at 2000 kgf/cm² and not at all at 4000 kgf/cm², indicating a total lack of plasticity and retention of a stress state. Successive pressing with intermediate sieve operations revealed that this laborious process only yields a 2% higher density at the higher pressures caused by brittle particle fracture and a more favorable distribution of the particles. In studying elastic aftereffect, using hollow samples, it was found that the aftereffect, as computed per $(d_i - d_o)/d_o \times 100$, grows in the 500-1000 kgf/cm² interval but drops from 0.9 to 0.6% at 1500 kgf/cm², which is associated with brittle fracture of interparticle linkages and protuberances of the particles with a resultant strengthening due to an attribute of the pressed parts. At higher pressures the elastic aftereffect again grows, which is accompanied simultaneously by the stratification phenomena. Sintering yields a sharp increase in density (by 25-28%), for both the vacuum- and non-vacuum treated samples, up to pressures of 3000 kgf/cm², after which density drops. Figures 4; references 8: all Russian.

USSR

UDC 621.762

EFFECT OF INTERNAL THERMAL STRESSES ON THE YIELD STRENGTH OF A SINTERED HARD ALLOY

Kiev POROSHKOVAYA METALLURGIYA in Russian No 4, Apr 78 pp 79-84 manuscript received 5 Jul 75

IVENSEN, V. A., CHISTYAKOVA, V. A. and EYDUK, O. N., All-Union Scientific Research and Design Institute of Hard Alloys and Refractory Metals

[Abstract] The study of a sintered hard alloy was made to verify a mathematical expression which can be used to show that the cobalt content of the hard alloy is a dominant factor related to the effect of internal stresses of thermal origin on yield strength of the hard alloy. Starting with a previously documented mathematical equation: $YS_a = YS_{TC}/1 + ba$, where YS_a is alloy yield strength, YS_{TC} is tungsten carbide yield strength, a is volume content of Co, and b is a coefficient that is constant for a series of hard alloys sintered under equal conditions, a final equation is derived, after introducing a coefficient of proportionality, q , in the form:

$$YS_a + qa/1 + ba = YS_{TC}/1 + ba \quad \text{or,}$$
$$YS_a = (YS_{TC} - qa)/1 + ba.$$

Analysis of experimental data with the aid of the last equation established a link of alloy yield strength with the tungsten carbide yield strength, whereupon this link can be followed up to a relatively high cobalt content (50%). Figures 1; references 8: 4 Russian, 4 Western.

USSR

UDC 621.762.4.06:621.777.31

LABORATORY UNIT FOR DYNAMIC HOT PRESSING OF POWDERS

Kiev POROSHKOVAYA METALLURGIYA in Russian No 4, Apr 78 pp 76-78 manuscript received 12 Aug 76

MARTYNOV, V. A., PETRENKO, V. P., AVDEYEV, N. V. and BEREZIN, R. G., Uzbek Combine of Refractory and High Temperature Metals

[Abstract] A description is given of a laboratory unit for dynamic hot pressing of different powders. Technical specifications for this unit are:

Impact mass, kg	50, 100, 200, 300
Impact mass height, meters	5
Heating temperature, °C	700-1600
Heating furnace power, kw	50
Productivity, parts/min	8-10
Dimensions of pressed part, mm (width x height x length)	200 X 100 X 200

Overall dimensions of unit, mm
(width x height x length) 1200 x 8100 x 2200
Weight, kg 1800

Doctor of Technical Sciences and Professor M. S. KOVAL'CHENKO provided consultation in the development of this unit. Figures 1.

USSR

UDC 621.762

SPECTROSCOPIC INVESTIGATION OF THE INTERACTION OF OXIDES WITH THE SURFACE OF METALS. IV. YTTRIUM OXIDE-CHROMIUM SYSTEM

Kiev POROSHKOVAYA METALLURGIYA in Russian No 4, Apr 78 pp 56-60 manuscript received 3 Oct 77

KARPINOS, D. M., LISTOVNICHAYA, S. P., BALAKHNINA, V. N., OKUNEVSKIY, YU. N.
and ROZANOV, K. V., Institute of Problems of Materials Science, Academy of
Sciences Ukrainian SSR

[Abstract] The compatibility of Y_2O_3 with Cr was studied by infrared spectroscopy in an effort to determine if an yttrium oxide coating could be used as a protective coating on Cr. A 0.3-micron film of Cr was vacuum deposited on a polikor [expansion unknown] substrate with 0.3-1.5-micron films of Y_2O_3 vacuum deposited on the Cr. Study of the absorption bands revealed that as temperature increases, intensity of the absorption bands also increases and the number of these bands increases with the growth of oxide-film thickness. This all adds up to the fact that the Y_2O_3 and Cr interact, with the interaction starting in the 1100-1200°C interval, to form an yttrium chromite. Figures 3; references 11: 10 Russian, 1 Western.

USSR

UDC 539.4:677-15

EVALUATING FIBER STRENGTH BY THE DRY CLUSTER METHOD

Kiev POROSHKOVAYA METALLURGIYA in Russian No 4, Apr 78 pp 51-55 manuscript
received 2 Jul 77

ZABOLOTSKIY, A. A., SLEDKOV, V. K., SAKHAROV, V. V. and SALIBEKOV, S. YE.,
All-Union Scientific Research Institute of Aviation Materials

[Abstract] The dry cluster method of evaluating the mechanical properties of fibers was studied in order to substantiate the correctness of the method and to develop it further for use in determining the parameters of

fiber strength distribution. The Weibull distribution and the gamma function were used to develop the mathematics for determining fiber strength in a dry cluster for both simultaneous and non-simultaneous loading. Experimental data obtained by testing dry clusters containing 80-85 fibers showed that this method is suitable for the purposes studied and that although fiber length and cross-section area are a function of strength the cluster is no stronger than the strength of the individual fibers. Figures 1; references 7: 6 Russian, 1 Western.

USSR

UDC 621.762

ON SOME PROPERTIES OF PERMEABILITY IN MATERIALS MADE FROM THIN IRON FIBERS

Kiev POROSHKOVAYA METALLURGIYA in Russian No 4, Apr 78 pp 47-50 manuscript received 27 Jan 77

MOROZ, A. L., KOSTORNOV, A. G., FEDORCHENKO, I. M. and FEDOROVA, N. YE., Institute of Problems of Science Materials, Academy of Sciences Ukrainian SSR

[Abstract] Uniform extruded iron fibers, 10-12 microns in diameter, with a rough surface were used to make disk samples 60 mm in diameter and 0.4-1.0 mm thick with porosities of 25-85% for studying the hydraulic and structural characteristics of permeable materials. For comparison, similar samples 1-3 mm thick were made with a smooth surface by drawing copper (20-micron diameter) and stainless steel (30-32 micron diameter) wires. Specific permeability was determined using TS-1 fuel; hermeticity was established by passing air through samples filled with B-70 gasoline. Results of structural measurements showed that the extruded-fiber samples had the finest porosity of all the materials studied, with maximum pore size being one-third less than in the drawn-fiber samples. Equality in absolute values of maximum pore size diameter occurs only in the case when thickness of the extruded-fiber samples is decreased to 0.7 mm and that of the drawn-wire samples is increased to 3 mm. Filters made with 30-micron stainless steel wire with a porosity of 40% had an absolute filtration fineness of 16 microns for a thickness of 1.2 mm while iron-fiber filters with the same porosity had the same filtration fineness for a thickness of 0.4 mm, i.e., one-third smaller in thickness. Figures 4; references 5: all Russian.

USSR

UDC 621.762.5:669.28:661.685.669

SINTERING ALUMINUM NITRIDE SYNTHESIZED IN A LOW-TEMPERATURE PLASMA

Kiev POROSHKOVAYA METALLURGIYA in Russian No 4, Apr 78 pp 25-29 manuscript
received 28 Apr 77

KUZENKOVA, M. A., KISLYY, P. S., MAKARENKO, G. N., ZYATKEVICH, D. P.,
KOSOLAPOVA, T. YA., MILLER, T. N. and GRABIS, YA. P., Institute of
Problems of Materials Science of Academy of Sciences Ukrainian SSR and
the Institute of Inorganic Chemistry, Academy of Sciences Latvian SSR

[Abstract] The sintering kinetics of aluminum nitride was studied using powders synthesized in a low-temperature plasma of high-frequency discharge on a laboratory unit of the Institute of Powder Metallurgy (AlN-1) and on a semi-industrial unit at the Special Technological Design Bureau for Nonferrous Metallurgy, Institute of Inorganic Chemistry (AlN-2) as well as powders produced by the Donets Chemical Reagents Plant (AlN-3). X-ray analysis showed that powders AlN-1 and AlN-2 contained only one phase while AlN-3 contained impurities of Al and Al_2O_3 in addition to aluminum nitride. Sintering of pressed samples showed that compaction of AlN-1 and AlN-2 starts at 1000°C and continues up to 1600°C , achieving an overall linear shrinkage magnitude of 25% and ending up in a nonporous state. Compaction of AlN-3 powder starts at 1400°C and proceeds smoothly to 2000°C with an overall shrinkage of 9%. The AlN-3 samples do not reach 100% density even at 1900°C due to the relatively low specific surface of the powder. The other two powders attain 100% density at 1600°C , which is maintained up to 1800°C , but when temperature is increased by 1900 - 2000°C the density drops to 97.5% as a result of AlN dissociation and vaporization at these temperatures. Figures 4; references 15:
13 Russian, 2 Japanese.

Steels

USSR

UDC 539.4

ON THE INFLUENCE OF THE CONDITION OF THE SURFACE OF CHROME-NICKEL STEEL SPECIMENS ON MECHANICAL PROPERTIES AT LOW TEMPERATURES

Kiev PROBLEMY PROCHNOSTI in Russian No 12, Dec 77 pp 52-54 manuscript received 1 Sep 76

NOVIKOV, N. V., GORODYSKIY, N. I., and UL'YANENKO, A. P., Institute of Problems of Strength, Academy of Sciences, Ukrainian SSR

[Abstract] Regression equations are produced, reflecting the variation in mechanical properties of 12Kh18N10T and 07Kh16N6 steels as functions of the combined influence of low temperature, structural heterogeneity and microgeometry of the surface of cylindrical specimens. The analytic expressions produced allow determination of the influence of various mechanical and heat treatments on the basic mechanical properties of these two very promising cryogenic structural steels in the temperature interval down to 4.2°K. References 5: all Russian.

USSR

UDC 669.14:539.4

PREDICTION OF THE HEAT RESISTANCE AND DUCTILITY OF STEELS AND ALLOYS ON THE BASIS OF DATA ON THE PARAMETERS OF THE FINE STRUCTURE AND STATE OF THE SOLID SOLUTION

Kiev PROBLEMY PROCHNOSTI in Russian No 3, Mar 78 pp 30-33 manuscript received 1 Sep 77

ADAMOVICH, V. K., MINTS, I. I., and RYBNIKOV, A. I., Central Scientific Research, Planning and Design Boiler and Turbine Institute; Ural Division of the All-Union Institute of Heat Engineering

[Abstract] Methods of stereometric and statistical metallography are applied to the data of optical and electron transmission microscopy, x-ray and phase analyses, and x-ray microanalysis in an attempt to predict the heat resistance properties and ductility of steels and alloys on the basis of their structural parameters and the condition of the solid solution. The dislocation density, size and number of special carbides, volumetric fraction of pearlite and absolute specific surface of cementite, phase composition, content of alloying elements in the solid solution and of carbides are determined for type 12MKh15KhM chrome-molybdenum steel and 12Kh1MF chrome-molybdenum-vanadium steel in the initial state and after usage for 100,000 hours at 510-565°C. Analysis of the results produced shows that the primary factors determining the flow stress are the hardening of the solid solution and hardening due to the presence of pearlite grains, special carbides and dislocations. The long-term strength, in contrast to short-term strength at room temperature, increases significantly with an increase in content

of molybdenum in the solid solution. The decrease in the long-term strength of pearlitic steels after use results to a great extent from the impoverishment of the solid solution in molybdenum, which largely goes over into various molybdenum carbides, particularly along the grain boundaries. The equations derived in this article are used to predict the ductility and strength of EI929 alloy and good agreement is achieved between calculated and experimental results. Figures 2; references 14: 11 Russian, 3 Western.

USSR

UDC 620.178.311.4

EFFECT OF TEMPERATURE ON THE RESISTANCE TO FATIGUE CRACK DEVELOPMENT IN ST. 3SP, 18 GPS AND 09 G2S STEELS

Kiev PROBLEMY PROCHNOSTI in Russian No 5, May 78 pp 45-50 manuscript received 25 Feb 77

GEORGIYEV, M. N., DANIKOV, V. N., MEZHOVA, N. YA., MINAYEV, V. N., RAKHMANOV, P. A., ROSHCHIN, S. N., and TYABLIKOV, YU. YE., Central Scientific Research Institute of the Ministry of Railways, Central Scientific Research Institute of Structural Parts, All Union Scientific Research Institute of Agricultural Machinery, Moscow

[Abstract] A study was made of the resistance to fatigue crack development of the most common structural steels, St.3sp, 18Gps and 09G2S. The crack growth rate of St. 3sp and 18Gps steels increases significantly as the test temperature drops to -40°C. The 09G2S steel does not become brittle or demonstrate a noticeable change in the crack growth rate at these temperatures. The results of statistical processing of the values of the stress intensity coefficient and the survivability factor and the effect of temperature on the relative variation of the survivability parameters are tabulated and explained from the point of view of rupture mechanics. Figures 6; references 11: all Russian.

USSR

UDC 669.14.018.821:539.52:669.781

INFLUENCE OF BORON ON THE DUCTILITY OF STAINLESS STEELS DURING HOT DEFORMATION

Moscow STAL' in Russian No 3, Mar 78 pp 259-262

BULAT, S. I., KARDONOV, B. A. and SOROKINA, N. A., Central Scientific Research Institute for Ferrous Metallurgy

[Abstract] A study is made of the influence of boron on the ductility of stainless steels in the temperature range of hot working at three levels of boron content: 0-0.1%, 0.01-0.2% and 0.2-2.0%. The effectiveness of increasing the hot ductility of stainless steels at the lowest level (up to 0.005%) is directly proportional to the content of sulfur in the steel and the severity of the stress state and inversely proportional to the content of carbon and the rate of deformation. At this level, boron is a modifier, increasing the strength of grain boundaries and decreasing the hot shortness of the steel at 900-1200°C by decreasing grain size and bonding harmful impurities. At over 1200-1220°C, boron has the reverse influence when present in these low quantities. As the boron content rises from 0.1 to 1.5%, intensive hardening of the austenitic stainless steel is observed between 20 and 900°C, accompanied by a significant decrease in ductility at 600°C and in a less significant decrease at higher temperatures. The maximum permissible temperature of deformation of austenitic stainless steel containing 0.5-1.5% B is 1150°C. Figures 3; references 10: all Russian.

USSR

ON THE ROLE OF ANNEALING TWINS IN THE GROWTH OF AUSTENITE GRAINS

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 3, 1978 pp 9-12

ZHAK, K. M., KAZIMIROVA, I. YE., MAREK, I. M. and POGREBNOY, E. N. (deceased), Dnepropetrovsk Metallurgical Institute

[Abstract] A study is made of the mechanism of hardening of austenite grains in 12Kh18N10T stainless steel. Hot rolled and hardened specimens with homogeneous fine grain structure were annealed in a laboratory chamber furnace at 900-1250°C with holding times of 10 to 60 minutes. The change in structure of the boundaries of recrystallization austenite grains during heating and the formation of discontinuities on the boundaries result from the appearance of annealing twins which grow from the points of discontinuities on the grains or near them. In large grains, many twins are observed which are not related to the grain boundaries.

These twins are unstable and disappear as a result of migration of the noncoherent boundaries for dissipation of low-mobility coherent twinning boundaries. The formation of annealing twins must be considered an intermediate stage in the disappearance of grain boundaries and anomalous grain growth by combination in metals and alloys with low packing defect energy. References 17: 11 Russian, 6 Western.

USSR

UDC 620.178.3+620.178.746

STUDY OF LOW TEMPERATURE EFFECTS ON THE LAWS OF DEVELOPMENT OF FATIGUE CRACKS IN 10GN2MFA STEEL

Kiev PROBLEMY PROCHNOSTI in Russian No 5, May 78 pp 40-44 manuscript received 26 Jul 77

POKROVSKIY, V. V., Institute of the Problems of Strength, Academy of Sciences Ukrainian SSR, Kiev

[Abstract] A study was made of the effect of low temperatures on the development of fatigue cracks in 10GN2MFA structural steel at temperatures of +20, -50, -70, -120, -165 and -190°C. The values of the coefficients C and N in the Paris equation used to process the experimental data are tabulated for this steel. As the test temperature dropped, the resistance to fatigue cracking increased over the entire range of test temperatures and amplitudes of the stress intensity coefficient. Figures 5; references 5: all Russian.

Superalloys

USSR

UDC 620.178.38

FATIGUE STRENGTH OF HEAT-RESISTANT TYPE EI607A AND EL929VD ALLOYS AS A
FUNCTION OF TEST TEMPERATURE

Kiev PROBLEMY PROCHNOSTI in Russian No 3, Mar 78 pp 9-11 manuscript
received 22 Feb 77

ISHCHENKO, I. I., KUFAYEV, V. N., LEVIN, YE. YE., GUGELEV, B. M., PIVNIK,
YE. M., and ZHELDUBOVSKIY, A. V., Kiev, Leningrad

[Abstract] Results are presented from studies of the fatigue strength of EI607A and EI929VD alloys at various test temperatures. EI607A contains 12-15% of the γ' phase, while EI929VD contains 45% of this phase, indicating its higher heat resistance. The strength of both alloys decreases with increasing temperature, while the yield point of EI607A first increases, then decreases at temperatures of over 600°C. The yield point of EI929VD remains practically the same up to 800°C, though relative elongation and reduction in area decrease up to 700°C, then increase up to 800°C. The fatigue test results were computer processed using the method of least squares to produce empirical regression lines. The fatigue curves of the two alloys are presented in the coordinates $\log \sigma$ vs. $\log N$, and generally show two clear branches. The change in fatigue strength with increasing temperature is typical for most heat-resistant nickelbased alloys.

References 3; references 4: all Russian.

Superhard Materials

USSR

UDC 621.921.27

INFLUENCE OF SINTERING TEMPERATURE ON THE ANNIHILATION OF POSITRONS IN BORON NITRIDE

Kiev SINTETICHESKIYE ALMAZY in Russian No 4, 1977 pp 5-9

DEKHTYAR, I. YA., MADATOVA, E. G., MIKHALENKO, V. S., TSAPKO, YE. A., and ADONKIN, V. T., Institute of Metal Physics, Academy of Sciences Ukrainian SSR, and CHIZHEK, A., Institute of Physical Metallurgy (CSSR)

[Abstract] A study was made of the variation in the angular distribution of annihilation photons with sintering temperature of boron nitride powder with sphalerite structure. The study was performed on microscopic cubic boron nitride powder containing less than 0.2 wt. % of hexagonal BN (α -BN) as an impurity. The method of positron annihilation allows information to be produced on the fine changes in structure occurring in BN crystals during high temperature deformation, and also allows the characteristic of the electron structure of the defect arising to be established.

References 9: 5 Russian, 4 Western.

USSR

UDC 666.233:669.017.1

CLASSIFICATION OF FUSIBILITY DIAGRAMS OF METAL-CARBON SYSTEMS IN CONNECTION WITH THE SYNTHESIS OF DIAMOND

Kiev SINTETICHESKIYE ALMAZY in Russian No 4, 1977 pp 9-13

BUTYLENKO, A. K. and SHURIN, A. K., Institute of Metal Physics, Academy of Sciences, Ukrainian SSR

[Abstract] The crystallization of diamond can be analyzed on a single physical-chemical basis, based on the fact that it is a polymorphous modification of carbon which, as a phase, can be present at high pressures in thermodynamic equilibrium not only with a metal melt, but also with other phases. Consequently, the conditions of existence of diamond should be described by a fusibility diagram of a system containing carbon: pressure vs. temperature vs. composition. Under thermodynamically stable conditions, diamond crystallizes from supersaturated metal solutions of carbon only in the hypereutectoid area of the fusibility diagram of the metal-carbon system. This is used as a basis to classify the construction of fusibility diagrams of binary and trinary systems of metals with carbon at atmospheric pressure, and the areas of possible diamond formation under pressure are indicated. Figures 3; references 13: 10 Russian, 3 Western.

Thermomechanical Treatment

USSR

INFLUENCE OF DEFORMATION OF AUSTENITES DURING HIGH-TEMPERATURE THERMO-MECHANICAL TREATMENT ON THE STABILITY OF HIGH-CARBON MARTENSITE DURING LOW TEMPERING

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 3, 1978 pp 24-27

BERNSHTEYN, M. L., KAPUTKINA, L. M., PROKOSHKIN, S. D. and DOBATKIN, S. B.

[Abstract] Type 80Kh5 steel (0.8% C, 4.5% Cr) was produced in an induction furnace and poured into 4-kg ingot molds. After homogenization, the ingots were forged into strips of 15 x 55 mm cross section, then annealed at 1000°C for 1 hour, cut and cleaned. Blanks measuring 14 x 55 mm with thicknesses of 8, 9.5 and 12 mm were heated for 20 minutes at 1100°C, then cooled for 2 minutes to 950°C, rolled in one pass at 15-20 s⁻¹ deformation rate with degrees of deformation of 15, 30 and 60% and cooled (immediately after rolling or after various holding times τ at the deformation temperature) in a 10% aqueous salt solution. The specimens were then tested, including electron microscope examination. It was found that hot plastic deformation of the austenite influences the kinetics of two-phase decomposition of martensite with low tempering. The martensite lattice period of the temper martensite is determined by the degree of two-phase decomposition of the martensite. High-temperature thermomechanical treatment usually accelerates tempering during the quenching of hardening and, depending on the hot deformation mode of the austenite, has a varying influence on two-phase martensite decomposition during subsequent load tempering.

Figures 4; references 5: all Russian.

Titanium

USSR

UDC 669.295

QUALITY OF REDUCING AGENTS AND HOMOGENEITY OF TITANIUM SPONGE IN A BLOCK

Moscow TSVETNYYE METALLY in Russian No 3, 1978 pp 44-45

GULYAKIN, A. I., VYATKIN, I. P., BERDNIKOVA, L. M., LUKASHENKO, G. S.,
and BRANDMAN, O. I.

[Abstract] A study is performed to refine the nature of the distribution of impurities from magnesium in a titanium sponge block and to provide a basis for a method of preparation of a reducing agent. Four series of 2 to 3 processes of reduction and vacuum separation were performed in industrial reactors, differing in the technology of preparation of the reducing agent for the process. All experiments used titanium tetrachloride of the same composition without preliminary vacuum removal of dissolved gases. It is found that the magnesium must be purified of iron in order to produce sponge of the required homogeneity. The technological steps necessary for removal of iron are known; development of industrial equipment for their performance is a priority project. References 4:
3 Russian, 1 Western.

USSR

UDC 539:4.620.178:669.295

ON THE CAPABILITY OF TITANIUM ALLOYS TO INHIBIT FAILURE DURING CYCLICAL
LOADING

Kiev PROBLEMY PROCHNOSTI in Russian No 12, Dec 77 pp 18-23 manuscript
received 17 Oct 76

DROZDOVSKIY, B. A. and PROKHODTSEVA, L. V., Moscow

[Abstract] A number of titanium alloys of various phase composition are compared as to their ability to inhibit fracture during cyclical loading. The influence of the strength and static toughness on $\log d_1/dN$ as a function of $\log K_{max}$ is investigated using sheets 1-3 mm thick of pseudo α , $\alpha+\beta$, and β alloys. An increase in strength increases the fracture resistance under cyclical loading up to a tensile strength of 100 kg/mm^2 ; further increases in strength result in a reduction in the fracture characteristics, particularly at high values of K_{max} ($>130 \text{ kg/mm}^{3/2}$). The pseudo α and $\alpha+\beta$ alloys VT20, VT22 and VT14 have the best fracture inhibition capabilities. The stress level of the cycle does not influence the characteristics studied in this article. Figures 2; references 13: 4 Russian, 9 Western.

USSR

ON THE MECHANISM OF HYDROGENATION OF TITANIUM ALLOYS DURING ELECTROCHEMICAL PROCESSES

Kishinev ELEKTRONNAYA OBRABOTKA MATERIALOV in Russian No 2, 1978 pp 14-16

SEDYKIN, F. V., NIKIFOROV, A. V., BORODIN, V. V., and BELOBRAGIN, YU. A.,
Tula

[Abstract] The concentration of hydrogen in the surface layer of specimens was determined following electrochemical treatment by means of an ISP-51 spectrograph. The results of the studies show that the content of hydrogen in the surface layer of VT5 and VT20 titanium alloys is 6 to 10 times greater than the concentration of hydrogen in the specimens before electrochemical treatment. A special mode is developed, with the oxidizer feed continued right up to the completion of electrochemical treatment, though it is interrupted each 4 seconds, which results in significantly less hydrogenation of the surface. Figures 2; references 8: all Russian.

USSR

UDC 669.295

SODIUM-THERMAL PRODUCTION OF MANGANESE-DOPED TITANIUM POWDER

Ordzhonikidze IZVESTIYA VUZov, TSVETNAYA METALLURGIYA in Russian No 2, 1978 pp 67-70 manuscript received 14 Feb 77

KUZ'MENKO, A. S., SANDLER, R. A. and SAL'DAU, E. P., Leningrad Mining Institute, Department of Metallurgy of Light and Rare Metals

[Abstract] Experimental studies were done on a laboratory scale to develop a sodium-thermal process of producing manganese-doped titanium powder. The initial materials are waste titanium sponge or VT1 alloy chips, electrolytic manganese with granularity of 0.5-1.0 mm, purified titanium tetrachloride and chemically pure potassium chloride. After charging, the reactor is evacuated and heated to 300-400°C, filled with argon, heating is continued to 800°C, the mixer is started, $TiCl_4$ is added with intense agitation, the heat is maintained at 770-800°C and agitation continues after the $TiCl_4$ is added for a period of 30-60 minutes. Sodium is fed to the intensely agitated surface of the melt to reduce chlorides of titanium and manganese. After cooling, the reaction mass is leached in a 1% solution of hydrochloric acid, and the metal powder is washed in water and dried. The manganese alloying can be controlled within limits from 0 to 15 mass percent. The powders are a solid solution based on the titanium crystal structure. As the manganese content increases, there is a linear increase in lattice parameter c , and an increase in the weighted mean value of particle size. Figures 2; references 4: all Russian.

INVESTIGATION OF THE INFLUENCE OF POSSIBLE DEVIATIONS OF TECHNOLOGICAL PARAMETERS OF THE PROCESSES OF REDUCTION AND SEPARATION ON THE QUALITY OF TITANIUM SPONGE

Moscow TSVETNYYE METALLY in Russian No 4, Apr 78 pp 49-50

CHEREPANOVA, YE. A., TITARENKO, A. I. and ALEKSANDROVSKIY, S. V.

[Abstract] Studies were done in a large titanium-magnesium enterprise under industrial conditions on high-capacity units to determine the influence of fluctuations in basic technological parameters of the process and shutdowns of equipment on the quality characteristics of titanium sponge. The factors that were investigated included the rate of feed of $TiCl_4$ into the reactor (v), the coefficient of magnesium utilization (K), and the duration of vacuum separation (T). Extremes were studied that differ appreciably from the series production conditions: $v = 270$ and 340 kg/hr ; $K = 55$ and 61% ; $T = 55$ and 75 hr . Quality control indices were hardness, content of controlled impurities in the commercial product and yield of titanium cinder and slag. Experimental data were processed by correlation analysis on the Minsk-32 and Promin'-2 computers. It was found that an increase in v increases the hardness of titanium slag sponge and chlorine content; an increase in K increases the chlorine content in the upper part of the block; lengthened aging reduces chlorine content in the commercial product and the bar. Interruptions in $TiCl_4$ feed increase the oxygen content in the commercial metal of the $-7+12 \text{ mm}$ fraction and in the central and lower parts of the block; prolonged heating of the separation equipment increases the iron content in the upper part of the block of titanium sponge. The investigated technological factors have a significant influence on the amount of oxygen in the cinder sponge of the $-70+12 \text{ mm}$ fraction, nitrogen in the central part, iron in the slag sponge, chlorine in the lateral and lower parts of the block, and also on the slag hardness in the central part of the block. The parameters K and v have almost no effect on the granulometric composition of the metal produced. The duration of the separation process has the greatest effect on granulometric composition. Long interruptions in the process increase the hardness of the refinery metal due to the increased content of nitrogen, oxygen and iron. On the basis of the results, steps have been taken to improve the quality of titanium sponge by stabilizing the temperature conditions during reduction and vacuum separation. In addition, the Kroll process has been introduced in semi-integrated installations, shortening the duration of interruptions and of the entire process. More rigid control of adherence to process specifications has been introduced. Figures 1; references 5: all Russian.

Welding

USSR

UDC 621.791.85

ON THE SHAPE OF THE CRATER FORMED BY ELECTRON-BEAM WELDING

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 2, Mar/Apr 78
pp 11-16 manuscript received 10 Mar 77

RODIGIN, V. N., Moscow

[Abstract] An attempt is made, based on the balance of the reactive force which arises when metal evaporates upon electron-beam welding with the hydrostatic pressure in the melted metal and the force of surface tension, to determine the equilibrium shape of a crater and estimate the variation in crater depth with parameters of the beam of electrons and the metal. The solution of the problem with the simplest square shape of electron beam intensity allows equations to be derived which permit estimation of the variation in crater depth with electron and metal parameters. As the radius of the crater decreases in comparison to its depth, the change in the direction of application of surface tension forces may cause the formation of bubbles at the base of the crater, which has been observed in practice. Figures 5; references 4: all Russian.

USSR

UDC 621.791.75

INFLUENCE OF A CONSTANT MAGNETIC FIELD ON THE STRUCTURE AND SUBSTRUCTURE OF THE METAL OF A WELDED SEAM

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 2, Mar/Apr 78
pp 94-98 manuscript received 12 Jan 77

MAKAROV, V. N., Ufa

[Abstract] A study is presented of the structure and substructure of the metal of a welded seam after crystallization with and without a magnetic field. An attempt is made to relate the structural changes to the general mechanical properties of the seam metal. The studies were performed using specimens of EI-620 alloy 1 mm thick welded at 30 A, 25 V, 20 m/hr with a field intensity of 1700 oe. The results indicate that there are significant changes in the structure and substructure of the seam metal when it is crystallized in a magnetic field, including a decrease in the density of dislocation etching figures and a change in the geometry of their placement, suppression of liquation effects and evening of the chemical composition between the axis and periphery of the dendrite formations. The growth of crystals in the magnetic field is similar to that in equilibrium conditions. Figures 2; references 16: 13 Russian, 3 Western.

USSR

UDC 621.791.763:669.018.9

SPOT WELDING OF AN ALUMINUM-BORON COMPOSITE MATERIAL

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 5, May 78 pp 18-21

RYAZANTSEV, V. I., ORLOV, D. B., and SHAVYRIN, V. N.

[Abstract] A study is made of the kinetics of formation of spot welds in an aluminum-boron (fiber) composite material. It is shown that the material can be welded in two ways -- with the formation of a cast core by primary melting of the cladding layer, or with the formation of joints in the solid phase. It is found that the high rigidity of the surface layer, slight thickness of the cladding layer and great anisotropy of properties require the use of special electrodes. The shape and dimensions of the electrodes are determined by the welding system and the thickness of the cladding layer. If the cladding layer is 50-150 μm thick and condenser-type welding machines are used, crimped electrodes should be used. Figures 3; references 3: all Russian.

USSR

UDC 621.791.72:669.715

ELECTRON-BEAM WELDING OF V93 ALUMINUM ALLOY

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 5, May 78 pp 17-18

SHARKOV, A. N., KLYKOV, N. A., Chelyabinsk Polytechnical Institute;
BONDAREV, A. A., Institute of Electric Welding imeni Ye. O. Paton;
and DEYEV, G. F., Lipetsk Polytechnical Institute

[Abstract] A study is made of electron-beam welding of V93 aluminum alloy in the thermally hardened state. The experiments were performed on tubular specimens with 35-mm wall thickness and 130-mm outside diameter. The static and fatigue strength of the welded joints are found to be less than the equivalent characteristics of the base metal by 23-27 and 10-15%, respectively. Figures 4; references 3: all Russian.

USSR

UDC 621.791.052:539.378.3:669.195

DIFFUSION WELDING OF T JOINTS OF VT6S TITANIUM ALLOY

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 5, May 78 pp 15-17

GEL'MAN, A. A., KOLODKIN, N. I., PAVLOV, V. M., LEONT'YEV, V. YA., and MIKHALEV, YU. D.

[Abstract] A study is made of the features of the structure and mechanical properties of T joints in VT6S titanium alloy produced by diffusion bonding with various types of local deformation of the metal in the area of the joint. Particular attention is given to joints produced by welding methods which simultaneously form chamfers. These chamfers decrease the stress concentration factor and increase the reliability of load-bearing parts which must operate under vibration loads for long periods of time. It is shown that contamination of the atmosphere in the vacuum chamber of the welding installation cannot be allowed, since it produces whisker defects in the areas of contact of the chamfers with the base metal. Figures 5; references 4: 1 Russian, 3 Western.

USSR

UDC 621.791.052.01:548.5:621.37.669.295

INFLUENCE OF AN ELECTROMAGNETIC FIELD ON THE PROCESS OF PRIMARY CRYSTALLIZATION OF TITANIUM

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 5, May 78 pp 1-3

ABRALOV, M. A., ABDURAKHMANOV, R. U. and YULDASHEV, A. T., Tashkent Polytechnical Institute

[Abstract] A study is made of the influence of application of an electromagnetic field on the process of primary crystallization of titanium by the method of microcinematography of the surface of the welded seam as it freezes. The studies were performed on type VT1-1 technical titanium 1 mm thick with an external magnetic field of 10 to 200 Gs. The application of the electromagnetic field increases the stability of the plane and cellular crystallization fronts. The degree of stability depends on the type of magnetic field and mode of magnetic processing. The formation of crystalline seeds before the advancing crystallization front was not observed. At 50-90 Gs, the width of unit cells is decreased by 1.5-2.0 times. An alternating magnetic field causes periodic changes in cell width. The optimal parameters of the magnetic field are: 50-90 Gs, 1-5 Hz, $\sigma=3.0-4.5$. Under these conditions, periodic changes in the direction of growth of the cells occur. Figures 7; references 4: all Russian.

USSR

UDC 621.791.052:620.193.01:669.14.018.44

INFLUENCE OF FORCED COOLING DURING WELDING ON THERMAL CRACKING OF HEAT-RESISTANT DISPERSION-HARDENED MATERIAL

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 4, Apr 78 pp 19-20

BIRMAN, U. I., PETROV, A. V., and SHVETS, M. YA.

[Abstract] Results are presented from a study of the method of forced local cooling by directed jet of the welded-joint zone of heat-resistant dispersion-hardened alloy EP199 1.5 mm thick during the process of welding. The essence of the method is that a cooling fluid is applied to the metal of the seam and the zone around the seam in the process of welding. Liquid nitrogen, water, liquid argon or other fluids may be used. Forced local cooling increases the resistance of the welded joints to the formation of cracks upon reheating. The resistance to thermal cracking is increased with increasing cooling rate in the interval of temperatures of intensive aging. Figures 6; references 5: 3 Russian, 2 Western.

USSR

UDC 621.791.052:621.78:669.14.018.44

INFLUENCE OF LOCAL HEAT TREATMENT WITH A PLASMA JET ON THE PROPERTIES OF WELDED JOINTS IN THE HIGH-STRENGTH STEELS 25KhGSA, VP-25 AND KVК-32

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 4, Apr 78 pp 17-18

REMIZOV, V. YE., NIKITIN, V. M., and BULYGIN, A. G., Moscow Institute of Aviation Technology

[Abstract] This article presents the results of a search for optimal modes of local heat treatment with a plasma jet for the welded joints in high-strength steels to prevent the development of cold cracks and improve the mechanical properties of the welded joints. It is found that local heat treatment with a plasma jet can have a favorable influence on the structure and properties of the seam metal and the metal around the seam, increasing impact toughness and maximum bending angle and decreasing hardness. Local heat treatment with a plasma jet should utilize modes in which the metal is heated to a temperature 30-100°C below the Az_1 point. Figures 3; references 5: all Russian.

USSR

UDC 621.791.72

USE OF A GLOW DISCHARGE IN THE ELECTRON-BEAM WELDING OF ALUMINUM ALLOYS

Kiev AVTOMATICHESKAYA SVARKA in Russian No 4, Apr 78 pp 47-49 manuscript
received 19 Jul 77

KRAVCHUK, L. A. and MOZOK, S. F., Engineers, Institute of Electric Welding
imeni Ye. O. Paton, Academy of Science Ukrainian SSR

[Abstract] Joining metals by electron-beam welding can be improved by using a glow-discharge technique to clean the metal prior to welding. This technique was used to hermetically seal AMg5 aluminum alloy housings for microcircuits where an additional electrode was added to a UL-109 electron-beam welding unit. Weld joints made using glow-discharge cleaning of the metals had a shear strength 3-4 times greater than with noncleaned materials. Joint leakage was reduced to less than 10^{-8} liter-micron/sec. Tests showed that when welding AMg5, which had been glow-discharge cleaned, the magnesium content in the heat-affected zone remained almost constant, but when not cleaned the Mg content dropped from 4.5 to 0.5%. Figures 4; references 8: 6 Russian, 2 Western.

USSR

UDC 621.791.4:539.378.3

FEATURES OF JOINT FORMATION IN THE DIFFUSION WELDING OF NIOBIUM WITH NICKEL AND ITS ALLOYS

Kiev AVTOMATICHESKAYA SVARKA in Russian No 4, Apr 78 pp 22-24 manuscript
received 6 Oct 77

KEDRIN, I. D., Candidate of Technical Sciences, and FESENKO, A. G., Engineer, Dnepropetrovsk State University

[Abstract] Double electron-beam remelted nickel and grade NVCh niobium were diffusion welded under a specific pressure of 1 kgf/mm² for 1-200 minutes at 850-1100°C to study weld joint formation of the two metals. At welding temperatures up to 900°C there is a visible boundary between the two metals, but after a certain latency period nucleation of an intermetallide zone starts to develop. This zone is initially comprised of Nb₃Ni (rhombic) and then NbNi (hexagonal), both of which have significant porosity due to the different partial diffusion coefficients. The micropores in the solid solution cause formation of elastic stresses whose recovery in turn causes interphase cracks. The strength of diffusion-welded Ni-Nb joints increases with temperature up to 1000°C and then decreases due to thickening of the intermetallide layer. When Nb is diffusion welded to nichrome alloys (Kh20N80 and KhN60B) the intermetallide thickness does not increase with temperature, resulting in greater tensile strength. Basically the strength of Ni-Nb weld joints depends on intermetallide thickness and degree of porosity. Figures 5; references 5: all Russian.

Miscellaneous

USSR

UDC 678:539.3

STRENGTH OF REINFORCED MATERIALS IN THE PLANE STRESS STATE

Kiev PROBLEMY PROCHNOSTI in Russian No 3, Mar 78 pp 86-90 manuscript
received 1 Mar 77

NIKOLAYEV, V. P., Moscow

[Abstract] Determination of the mechanical characteristics of the material of a wound shell must be performed on tubular specimens, so that the stress conditions approximate those actually encountered in use in the shell. Material strength characteristics for specimens of this shape are rarely found in handbooks. Nine types of stress state are selected which are convenient for the determination of the components of the strength tensors. Types of tests are selected and testing machine attachments designed to be used in testing tubular specimens. A foundation is thus laid for the selection of a sufficient number of types of strength tests to allow a well-founded evaluation of the strength of a multilayer reinforced wound shell material in the plane stress state in the plane of the reinforcement. Figures 6; references 11: all Russian.

USSR

FORMATION OF SURFACE MICRORELIEF DURING ELECTROCHEMICAL TREATMENT OF HEAT-RESISTANT NICKEL-CHROMIUM ALLOYS

Kishinev ELEKTRONNAYA OBRABOTKA MATERIALOV in Russian No 2, 1978 pp 17-21

DIKUSAR, A. I., PETRENKO, V. I. and PETROV, YU. N., Kishinev

[Abstract] A study is made of the regularities of formation of the surface microrelief during electrochemical treatment of heat-resistant nickel-chromium alloys in solutions of chlorides and nitrates at current densities of 10-70 A/cm² as a function of phase composition. The data indicate that the electrochemical properties of the individual phase components play a decisive role in the formation of the surface microrelief of the alloy studied, which contradicts the conclusions reached in earlier works. Figures 4; references 16: 12 Russian, 4 Western.

USSR

UDC 621.791.793

ELECTROSLAG SURFACING OF A STEEL PART USING AN ALLOY CONTAINING BORON NITRIDE

Kiev AVTOMATICHESKAYA SVARKA in Russian No 4, Apr 78 pp 74-76

SVETLOPOLYANSKIY, V. I., Candidate of Technical Sciences, ORESHKIN, V. D., Doctor of Technical Sciences, and DAN'KIN, A. A., Candidate of Technical Sciences

[Abstract] The technology of electroslag surfacing of steel parts using a charge containing boron nitride was developed by the Volgograd Structural Engineering Institute with consultation expertise provided by G. V. SAMSONOV (deceased). The method was used to surface St4sp steel parts using charges containing 25, 50, 75 and 100% BN. The first layer serves as the transition layer to provide a strong and reliable bond with the base metal. The second and subsequent layers provide wear resistance and can be done without wetting and surface-active substances. Tests showed that with increased BN content in the charge the hardness of the surface layers increases and wear decreases by 7-8 times. Figures 3; references 5: all Russian.

USSR

UDC 620.178.2

MECHANICAL AND PHYSICAL FEATURES OF METAL FAILURE

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 4, Apr 78 pp 2-13

KRISHTAL, M. A. and EPSHTEYN, L. YE.

[Abstract] Two approaches to the problem of strength and failure--mechanical and physical--of materials were examined in this literature survey. The mechanical approach had to do with the question of equilibrium in a material already having a crack in a force field while the physical approach involved formation and growth of cracks and their interaction with the structural elements of the material. The characteristics of interatomic bonding were examined along with the applicability of a quasi-elastic force which is characteristic of temperature and modulus of elasticity for determining crystal lattice strength. Behavior of cracks under load was analyzed where it has been shown that atomic points are the critical dimension for brittle fracture of cracks. The effect of the contribution of interatomic bonding in a crack to failure energy was investigated in relation to the concepts of Griffith (1920) and Orowan (1948) and the physical characteristics of brittle and ductile failure given along with calculation of the elastic energy of a material during crack growth. Irwin's theory (1948) and

the criteria of ductile fracture were examined in relation to the critical phenomena of ductile-to-brittle failure and critical crack size. Figures 5; references 14: 10 Russian, 4 Western.

USSR

UDC 669.295'296:539.219.3:669.788

DIFFUSION OF HYDROGEN IN TITANIUM AND ZIRCONIUM ALLOYS

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian
No 4, Apr 78 pp 75-77

BARASHEVA, T. V., ANISIMOVA, I. A., GUS'KOVA, YE. I. and YERMOLOVA, M. I.

[Abstract] The coefficients of hydrogen diffusion in titanium and zirconium alloys were determined at ambient and higher temperatures using layer spectral analysis. Diffusion coefficients were determined in VT3-1 (alpha'), VT15 (beta), and VT3-1 (alpha + beta(18% beta-phase)) titanium alloys and in Zr-2.5 Nb-0.5 Cu-0.1 O₂ and Zr-2.5 Nb alloys, both of which contain alpha- and beta-zirconium phases (with 10-15% Nb) by etching in solutions containing varying amounts of H₂O, HF, HNO₃ and H₂SO₄ for at least two hours. The diffusion equations for a source of infinitely small thickness and for diffusion from a medium of constant concentration were used to determine the coefficients. Comparison of calculations with literature data showed that the equation for the constant concentration medium produced higher values while the equation for a thin layer produced results which coincided with those of other authors. The coincidence of experimental data with literature data confirms the preservation of the temperature function of the coefficient of hydrogen diffusion in the studied alloys upon lowering temperature to room temperature and makes it possible to determine the diffusion coefficient for these alloys over a wide range of temperatures. N. F. LASHKO and V. I. BEZGIN participated in this work. Figures 1; references 10: 6 Russian, 4 Western.

USSR

UDC 546.289'78:542.65

HIGH PRESSURE SYNTHESIS OF TUNGSTEN GERMANIDES

Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 14, No 4, Apr 78 pp 684-686
manuscript received 7 Apr 77

POPOVA, S. V. and FOMICHEVA, L. N., Institute of High Pressure Physics

[Abstract] High purity W and Ge were synthesized in the course of 2-5 minutes under a pressure of 77 kbar at 1500-2500°C. Intermediate phases with compositions W_5Ge_3 and WGe_2 were formed. Two modifications of W_5Ge_3 were formed; one with a W_5Si -type tetragonal structure and one with a Cr_5B_3 tetragonal structure. The WGe_2 compound crystallized in an $MoSi_2$ -type structure. Space grouping, lattice parameters, and calculated and pycnometric densities are given. The synthesized samples were vacuum roasted at 1000°C for five hours during which both W_5Ge_3 phases remained stable while the WGe_2 decomposed completely into its initial components.

References 4: 2 Russian, 2 German.

USSR

UDC 669.11:539.89

EFFECT OF GRAPHITIZING ELEMENTS ON EQUILIBRIUM WITH THE MELT IN THE IRON-CARBON SYSTEM AT HIGH PRESSURES

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 45, No 3, Mar 78 pp 569-579 manuscript received 8 Apr 77

KAMENENTSKAYA, D. S., KORSUNSKAYA, I. A. and LITVIN, YU. A., Institute of Physical Metallurgy and Metal Physics, Central Scientific Research Institute of Ferrous Metallurgy imeni I. P. Bardin

[Abstract] Thermodynamic calculations were performed and experiments conducted to study the effect of graphitizing elements Al and Si on Fe-C equilibrium at high pressure (up to 100 kbar). The thermodynamic equations were derived from standard data for the elements involved and calculations performed on a Minsk-22 computer with the end result of plotting ternary phase diagrams for the Fe-C-Al and Fe-C-Si systems at the Fe corner. Thirteen alloys were then produced (7 with Al, 6 with Si) by high-pressure melting (80 Kbar) followed by slow cooling (10 deg/min) in the 1700-1000°C interval. Comparisons of theoretical and experimental results showed that the phase composition of alloys with primary crystallites of austenite, cementite and graphite totally agreed. Equilibrium with cementite is stabilized in the two systems under high pressure despite the presence of significant amounts of graphitizing elements. The presence of Al and Si also creates a region of melt-diamond equilibrium and, with increased pressure, this region expands to the side with the smallest amounts of

alloying element and increased carbon concentration. Under the action of Al and Si the stable crystallization of diamond is shifted to the side of smallest pressures, temperatures and carbon concentrations in comparison with the Fe-C binary system. The region of actual diamond crystallization lies inside the region of stable melt-diamond equilibrium and should be bounded by the lines of melt metastability relative to the diamond. In the two ternary systems it is possible to produce "diamond pig iron" containing diamond inclusions and an austenite-cementite eutectic. The authors thank L. P. IL'INAYA for making the computer calculations and V. G. KOSTOGONOV for conducting the microspectral analysis. Figures 5; references 27: 20 Russian, 7 Western.

USSR

UDC 661.66:577:539.211

ON THE REASONS FOR THE LOSS OF STRENGTH OF CARBON FIBERS WHISKERED WITH THREAD-LIKE SILICON CRYSTALS

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 2, Mar/Apr 78
pp 151-154 manuscript received 2 Jun 77

SHCHETININ, A. A., BUBNOV, L. I., DAVYDOV, YU. A. and LITVINOV, A. N.,
Voronezh

[Abstract] A study was made of the influence of the quantity of silicon carbide thread-like crystals formed on the surface of a fiber on its strength properties. A scanning electron microscope, chemical analysis and mechanical testing were used to analyze the reasons for the decrease in strength of carbon fibers following whiskering with thread-like crystals in the system $\text{SiCl}_4\text{-H}_2$. It is shown that in addition to the thread-like crystals of silicon, thread-like crystals of silicon carbide are formed on the surface of the carbon fibers due to etching of the fiber. Figures 3; references 4: 3 Russian, 1 Western.

USSR

UDC 669.04:621.791

ON THE CALCULATION OF PLASMA-ARC REFINING REMELTING. EVALUATION OF A MODEL
ON THE BASIS OF EXPERIMENTAL RESULTS

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 2, Mar/Apr 78
pp 70-74 manuscript received 4 Apr 77

DOBROVOL'SKIY, I. P. and YEROKHIN, A. A., Moscow

[Abstract] This work completes a cycle of publications on the problem of plasma-arc refining. Convenient and relatively simple formulas are

presented for calculation of the degree of refining, and the calculated results are compared with experimental data to yield values of certain constants included in the calculation formulas. An interpolation curve is presented describing the variation in parameter B (the fraction of inclusions removed with the slag at the metal-gas boundary) as a function of the linear melting rate of the electrode blank. The results of experiments on the refining of chrome-nickel steel to remove oxide inclusions confirm the suitability of the model suggested of the refining process. Figures 2; references 5: 4 Russian, 1 Western.

USSR

UDC 539.4:538.6

DYNAMICS OF FRACTURE OF MATERIAL AT THE TIP OF A CRACK UNDER THE INFLUENCE OF A STRONG ELECTROMAGNETIC FIELD

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 2, Mar/Apr 78
pp 40-46 manuscript received 10 Jun 76

DOLOVIN, YU. I., FINKEL', V. M., SLETKOV, A. A. and SHIBKOV, A. A., Tambov

[Abstract] An experimental study is presented of the kinetic and other features of the fracture of metal at the tip of a crack which forms a sort of microsolenoid. The dynamics of the process of fracture at the tip of a crack was studied in plates of several types of steel, aluminum, iron plus silicon using an installation which created a potential gradient perpendicular to the plane of an edge notch by discharging a high voltage battery of condensers. It is shown that the effect of current concentration at the tip of the crack may generate fields of millions of oersteds in tiny volumes at the crack tip with a mean current through the specimen of 10^5 A/cm². The radius of curvature at the tip of the crack increases by two or three orders of magnitude in a few microseconds when this occurs, which can be used for instantaneous suppression of potential main failure cracks or dangerous mechanical stress concentration. Figures 4; references 10: all Russian.

USSR

SUPERPLASTICITY OF V96Ts ALLOY

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 3, 1978 pp 55-56

RABINOVICH, M. KH., KAYBYSHEV, O. A. and TRIFONOV, V. G., Ufa Aviation Institute imeni Ordzhonikidze

[Abstract] The low ductility of V96Ts alloy makes it interesting to study the possibility of increasing the technological ductility of the alloy and decreasing its resistance to plastic deformation during hot stamping. A fine grain structure, allowing superplasticity to be achieved, can be developed in V96Ts alloy by deformation and heat treatment, causing primary recrystallization from a large number of centers. A hot pressed bar of V96Ts alloy (7.6% Zn, 2.3% Cu, 2.75% Mg, 0.15% Zr, remainder Al) was hot rolled at 90% deformation and specimens were cut from the 1-mm-thick sheet produced and deformed by extension at $465 \pm 5^\circ\text{C}$ at $5.5 \cdot 10^{-5} - 2.8 \cdot 10^{-2} \text{s}^{-1}$. It was found that V96Ts alloy with fine-grain structure (grain diameter 5 μm) manifests superplasticity in extension at $460 - 470^\circ\text{C}$. The specimens stretch evenly, without the formation of a typical neck. Figures 3; references 4: 3 Russian, 1 Western.

USSR

STUDY OF PHENOMENA AT THE INTERPHASE BOUNDARY BETWEEN CARBON FIBER AND NICKEL FILM UNDER UNSTEADY CONDITIONS

Kishinev ELEKTRONNAYA OBRABOTKA MATERIALOV in Russian No 1(79), 1978 pp 40-42

MAZUR, V. A., PONOMAR', V. V. and YAGUBETS, A. N., Kishinev

[Abstract] A study is made of the phenomena occurring at the interphase boundary between a carbon fiber and electrolytic nickel film up to 1 μm thick upon heating to up to 1000°C at heating rates of 2.5 to $20^\circ\text{C}/\text{min}$. The tests were performed in air and in an argon atmosphere purified of oxygen and moisture. Thin nickel films on carbon fibers, when heated at an even rate in an atmosphere of purified argon to 1000°C , are found to evaporate, leaving spikes of the metal on the surface of the fibers. When the fibers are evenly heated at 10 and $20^\circ\text{C}/\text{min}$ in air at temperatures of over 700°C , the fibers are cleansed of the coatings, which are oxidized to the lower oxide of nickel. Figures 4; references 2: both Russian.

USSR

UDC 669.141.15.018.8

STUDY OF THE STRUCTURE AND PROPERTIES OF PLASTICALLY DEFORMED HARDENED MEDIUM CARBON CHROME STEELS

Moscow IVUZ. CHERNAYA METALLURGIYA in Russian No 3, 1978 pp 135-139
manuscript received 13 Jul 77

BERNSHTEYN, M. L., KAPUTKINA, L. M., MEDVEDEV, V. G. and MEL'NIKOV, V. P.,
Moscow Institute of Steel and Alloys

[Abstract] This work presents a study of the influence of temperature (20-200°C) and degree of deformation (0.3-3%), as well as subsequent low tempering (100-200°C) on the structure and properties of hardened medium-carbon steels, both unalloyed (type 45) and chrome steels (45Kh2) and 45Kh4). The steels were produced in an induction furnace and poured into an 8 kg ingot. Preliminary processing consisted of homogenization at 1100°C for 6 hours, forging to plates measuring 10 by 25 mm, annealing at 830-900°C for 1-2 hours, and cutting into specimens of ferrite and plate pearlite structure. All specimens were then hardened, then either not tempered, or low tempered at 100-200°C; hardened with plastic deformation at 20-200°C without subsequent tempering; or hardened with plastic deformation with tempering at the deformation temperature for 1 hour. The optimal treatment was found to be 1% deformation at 200°C for type 45 and 45Kh2 steels, and 1% deformation at 150°C for 45Kh4 steel, producing an increase in strength, ductility and impact toughness.

USSR

UDC 669.018.25:621.762

PROPERTIES OF THE ALLOY T15K6 BASED ON "DIRECT FLOW" TUNGSTEN POWDER

Moscow TSVETNYYE METALLY in Russian No 3, 1978 pp 71-72

PANOV, V. S., KIPARISOV, S. S. and GLUSHKOV, V. N.

[Abstract] The Moscow Hard Alloys Combine has developed and introduced a process of production of tungsten by direct-flow feed of hydrogen into a muffle furnace (the hydrogen is fed into the furnace in the same path through which the boats containing WO₃ move), allowing the production of homogeneous, fine-grained tungsten powder in one stage without reducing the production rate of the reducing furnace, with adsorption of methanol greater than 0.2 mg/g. This work studies the properties of the mixtures and of T15K6 alloy produced using the "direct flow" tungsten and compares them with the properties of standard T15K6 alloy. Based on the studies performed, optimal modes are selected for manufacture of the alloy. The results of testing at machine-building plants show that the T15K6 alloy prepared on the basis of the "direct flow" tungsten is 30-50% more durable than standard T15K6 alloy. Figures 1.

USSR

UDC 669.2:621.77

DETERMINATION OF THE CAPABILITY OF MATERIALS FOR DEFORMATION BY DRAWING

Moscow TSVETNYYE METALLY in Russian No 3, 1978 p 62

GRIGOR'YEV, A. K., SMAGORINSKIY, M. YE. and LIBERMAN, M. D.

[Abstract] A method is suggested consisting in one-time drawing with lubrication through a die of a specially prepared specimen with a cross section which decreases in the drawing direction until the specimen fails in the portion which has been drawn through the deformation focus. The quantitative measure of the capability of the material for deformation by drawing is K , where $K = \ln \mu/\sigma$, μ is the maximum drawing at the point of failure of the specimen, and σ is the maximum tensile stress reached in the test. The method has been included in standard GOST 20967-75 and is used to test aluminum designed to be drawn into wire.

USSR

UDC 669.24.5

INFLUENCE OF CHEMICAL COMPOSITION ON PROPERTIES OF THE ALLOY KhN67VMTYu

Moscow STAL' in Russian No 3, Mar 78 pp 262-263

DORONIN, I. V., MAKARENKO, V. I., CHERNUKHA, A. I. and NUD'GA, G. S., Electric Steel Affiliate of Moscow Institute of Steel and Alloys; "Elektrostal'" Plant

[Abstract] The authors study the influence of the primary alloying elements on the hot mechanical properties and short-term creep of the alloy KhN67VMTYu (EP202) by a statistical processing of the results of acceptance testing of over 400 industrial melts. It is found that the main hardening elements are aluminum, carbon, titanium and molybdenum. The upper limit of the temperature interval for rapid deformation is 700°C. Considering the specific influence of aluminum and titanium as well as precipitates, it is recommended that the content of aluminum be increased from 1.0-1.5 to 1.2-1.7%, and the content of titanium be decreased from 2.2-2.8 to 2.0-2.6%. The chemical composition is not the only factor influencing the mechanical properties of this steel; particularly, the microstructure, mostly formed during hot working and subsequent heat treatment, is very significant. Figures 3; references 10: 9 Russian, 1 Western.

CSO: 1842

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